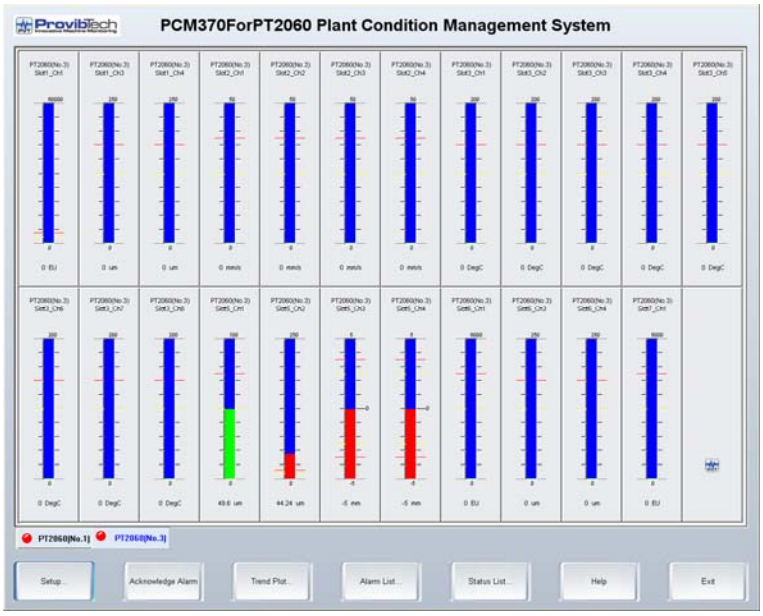
PCM370ForPT2060

Plant Condition Management System

User Manual

Installation, Operation, Maintenance



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PCM370ForPT2060 Introduction

Introduction

PCM370ForPT2060 is a type of plant condition monitoring system that is specially designed for PT2060 Rack. PT2060 Rack can be automatically integrated into the PCM370ForPT2060 system. Similarity with other plant condition monitoring systems from ProvibTech, PCM370ForPT2060 can collect, store, analyze the data from PT2060 Rack, and also it is capable of transmitting the machine status information to local network or internet.

Features

- ✓ Only for PT2060 Rack
- ✓ Integrate process data
- ✓ User friendly system with touch panel
- ✓ ProvibTech's database
- ✓ Data collection with time trigger and/or alarm trigger
- ✓ Software alarms to indication of machine status
- ✓ Modbus data collection and storage

Running Environment

Minimum system requirement:

- ✓ **Operation system:** Windows XP or Windows 2000
- ✓ **CPU:** P4 800MHz
- ✓ **Memory:** 512MB
- ✓ **Hard Disk:** 40G
- ✓ **Display:** Touch panel or VGA

Quick Configuration Guide

System Wiring

Connect the PT2060 Racks to the computer. You can refer to **Field Wiring Diagram** on ***PCM370ForPT2060 User Manual.***

System Installation

Install PCM370ForPT2060 software on the computer.

System Configuration

CAUTION: Make sure all PT2060 Racks have been already correctly configured by PT2060-CFG software. You should pay attention to the following settings on PT2060 Racks.

A. Rack Slave Address Setting: Ensure the slave addresses of racks are in range from 1 to 5 and each slave address identifies a unique PT2060 Rack. You could refer to ***PT2060/91 SIM System Interface Module User Manual*** to get detailed information about Rack Slave Address Setting.

B. Other communication parameters Setting:

- If PT2060 Rack uses MODBUS-RTU transmission mode, you should set the communication parameters as below:
  - ✓ **Baud Rate:** 19200
  - ✓ **Stop Bit:** 2
  - ✓ **Parity Bit:** None
- If PT2060 Rack uses MODBUS-TCP transmission mode, you should set the valid Rack IP Address for each rack. The format of IP Address is "A.B.C.D". A should be from 1 to 223 and can't be 127; B should be from 0 to 255; C should be from 0 to 255; D should be from 0 to 255. PCM370ForPT2060 software scans maximum ten consecutive IP addresses that begin with the Starting IP. **Make sure the "A.B.C" fields of Rack IP are the same as those of the host computer IP.** And we recommend that the racks in the system are set with the consecutive IP Addresses. For example: the computer IP is 192.168.1.1 and the system contains 5 PT2060 Racks. You could set the racks' IP as "192.168.1.100", "192.168.1.101", "192.168.1.102", "192.168.1.103" and "192.168.1.104" if the five IP addresses are not used yet.

The system configuration process is below:

1. Run PCM370ForPT2060 software.

2. Set communication parameters in Search Option window.

A. If PT2060 Rack uses MODBUS-RTU transmission mode, you should select "MODBUS-RTU" and then click OK.

B. If PT2060 Rack uses MODBUS-TCP transmission mode, you should select "MODBUS-TCP" and then set the valid Port and Starting IP. And then click OK. The default Port is 502. Type the minimum rack IP address in field of "Starting IP". For example, there are five PT2060 racks in the system. The IP addresses of the racks are

"192.168.1.100", "192.168.1.101", "192.168.1.102", "192.168.1.103" and "192.168.1.104". So you should type "192.168.1.100" in field of "Starting IP".

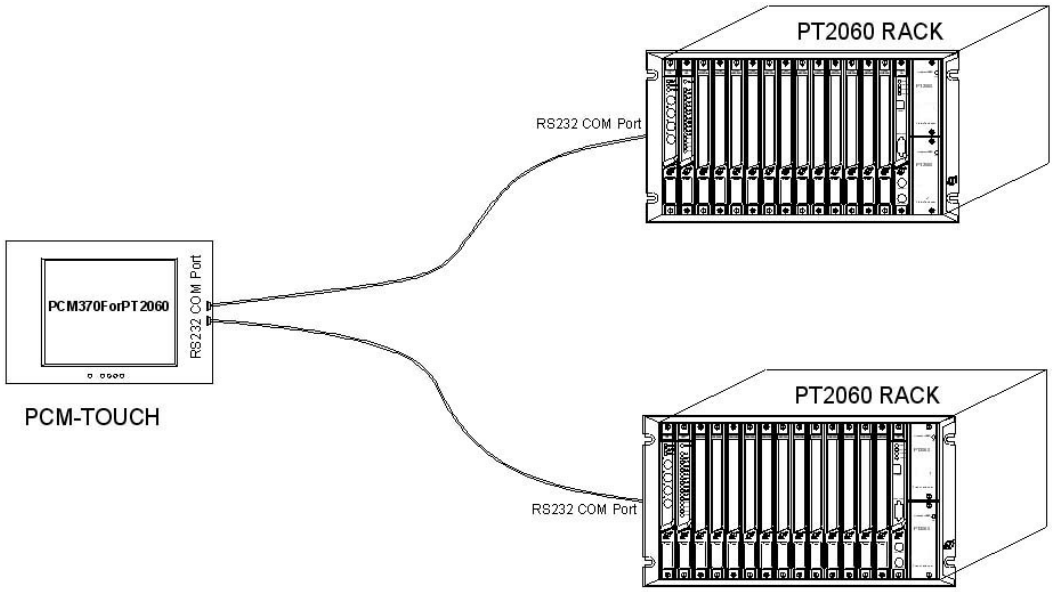
PCM370ForPT2060 software will upload the information from PT2060 Racks. If you want to set other parameters, you can click **Setup** button on main window. Default password is **"password"**.

PCM370ForPT2060 Installation

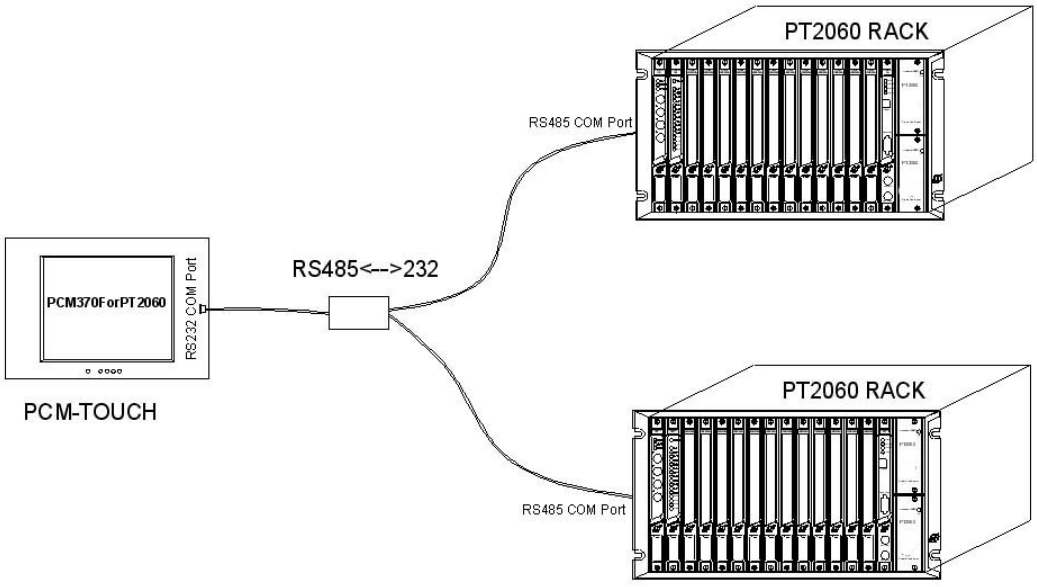
Field Wiring Diagram

NOTE: A PCM370ForPT2060 system can monitor maximum 5 PT2060 Racks.

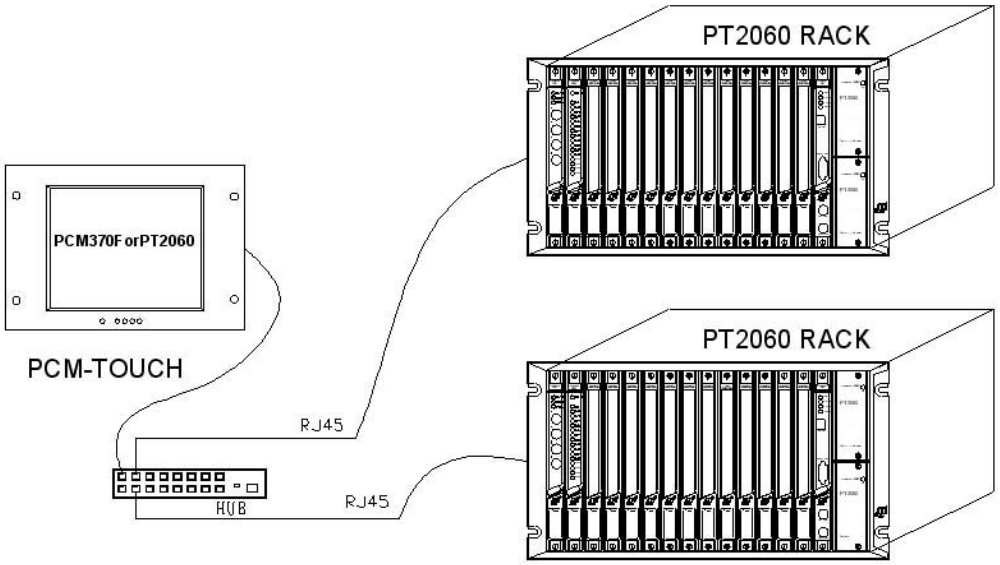
Field Wiring Diagram 1-MODBUS-RTU for Short Distance



Field Wiring Diagram 2- MODBUS-RTU for Long Distance



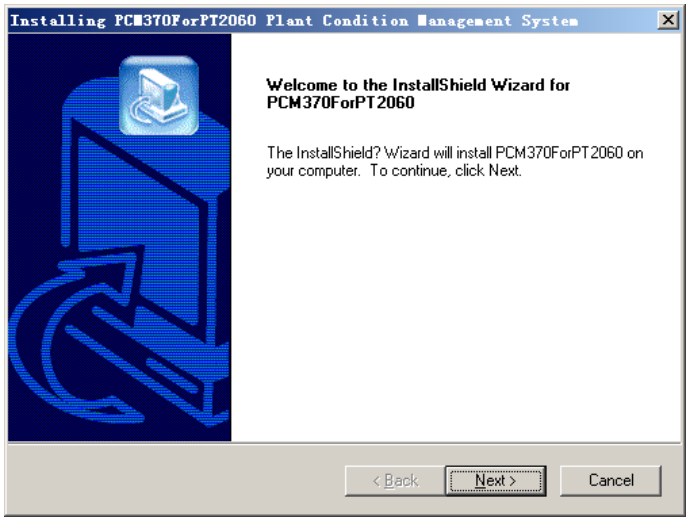
Field Wiring Diagram 3-Modbus-TCP



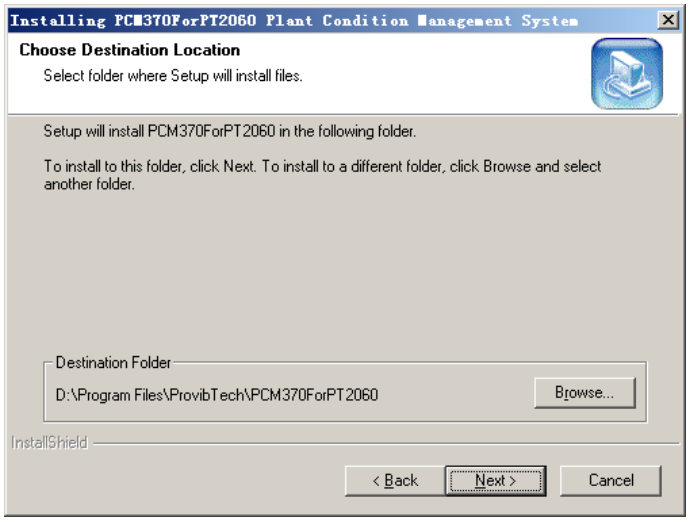
Install PCM370ForPT2060 Software

Put the installation CD into CD-driver, supposing that the CD-driver is G and then double-click file of Setup.exe in directory of "G:\PCM370ForPT2060-Setup" to start this installation program.

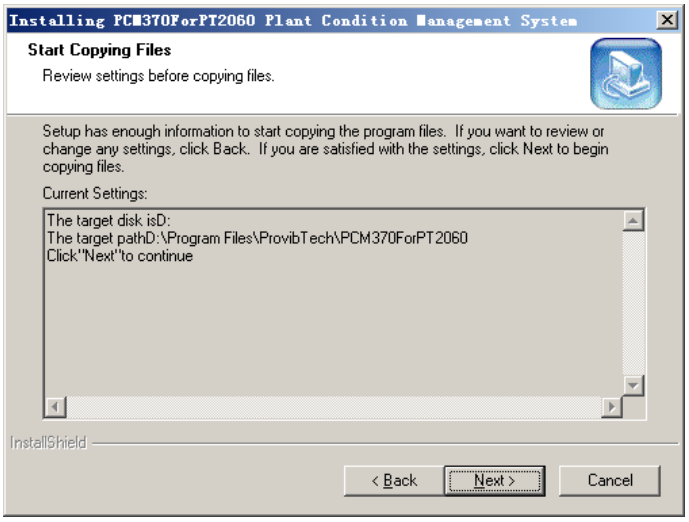
1. Show welcome information. Click **Next** to continue.


Installing PCM370ForPT2060 Plant Condition Management System
Welcome to the InstallShield Wizard for PCM370ForPT2060
The InstallShield? Wizard will install PCM370ForPT2060 on your computer. To continue, click Next.
< Back
Next >
Cancel

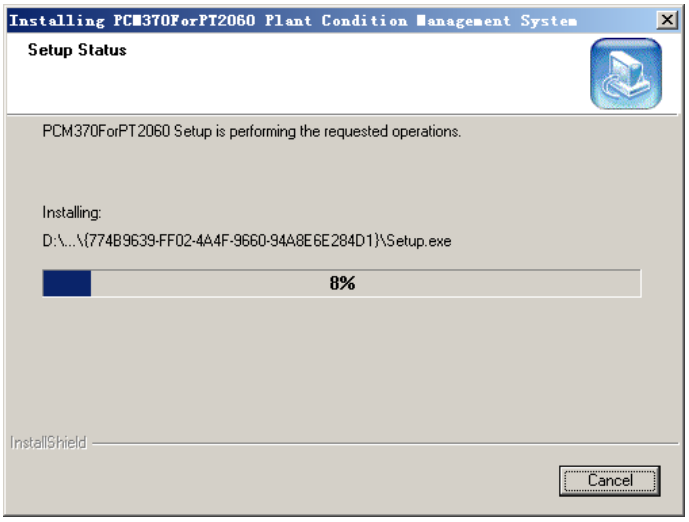
2. Click **Browse…**button to select a destination folder or use the default folder. Then click **Next** to continue.


Installing PCM370ForPT2060 Plant Condition Management System
Choose Destination Location
Select folder where Setup will install files.
Setup will install PCM370ForPT2060 in the following folder.
To install to this folder, click Next. To install to a different folder, click Browse and select another folder.
Destination Folder
D:\Program Files\ProvibTech\PCM370ForPT2060
Browse...
InstallShield
< Back
Next >
Cancel

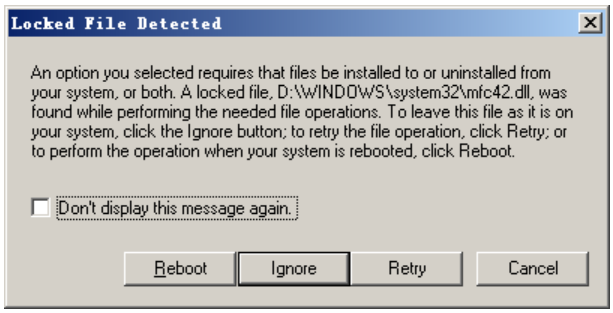
3. Show current settings about copying files. Click **Next** to continue.


Installing PCM370ForPT2060 Plant Condition Management System
Start Copying Files
Review settings before copying files.
Setup has enough information to start copying the program files. If you want to review or change any settings, click Back. If you are satisfied with the settings, click Next to begin copying files.
Current Settings:
The target disk isD:
The target pathD:\Program Files\ProvibTech\PCM370ForPT2060
Click"Next"to continue
InstallShield
< Back
Next >
Cancel

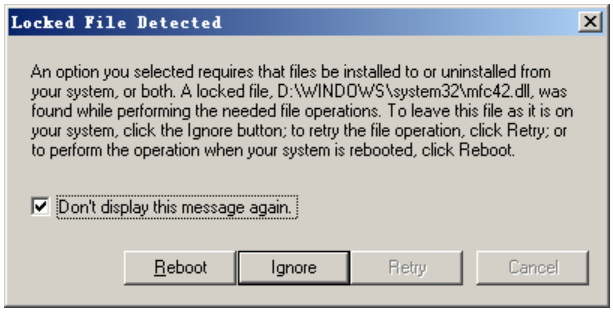
4. Show copying status window.



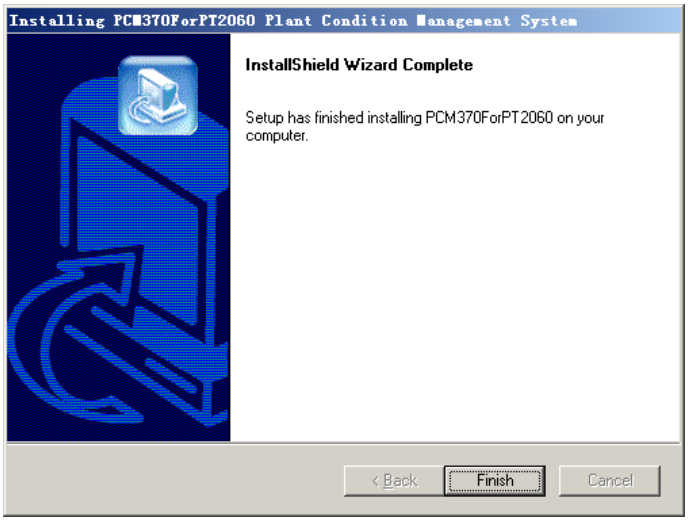
If you see **Locked File Detected** window in the process of copying files (see below picture), please check option of "Don't display this message again".


Locked File Detected
An option you selected requires that files be installed to or uninstalled from your system, or both. A locked file, D:\WINDOWS\system32\mfc42.dll, was found while performing the needed file operations. To leave this file as it is on your system, click the Ignore button; to retry the file operation, click Retry; or to perform the operation when your system is rebooted, click Reboot.
Don't display this message again.
Reboot
Ignore
Retry
Cancel

And then click **Ignore** button. See below:


Locked File Detected
An option you selected requires that files be installed to or uninstalled from your system, or both. A locked file, D:\WINDOWS\system32\mfc42.dll, was found while performing the needed file operations. To leave this file as it is on your system, click the Ignore button; to retry the file operation, click Retry; or to perform the operation when your system is rebooted, click Reboot.
Don't display this message again.
Reboot
Ignore
Retry
Cancel

5. Installation complete. Click **Finish**.

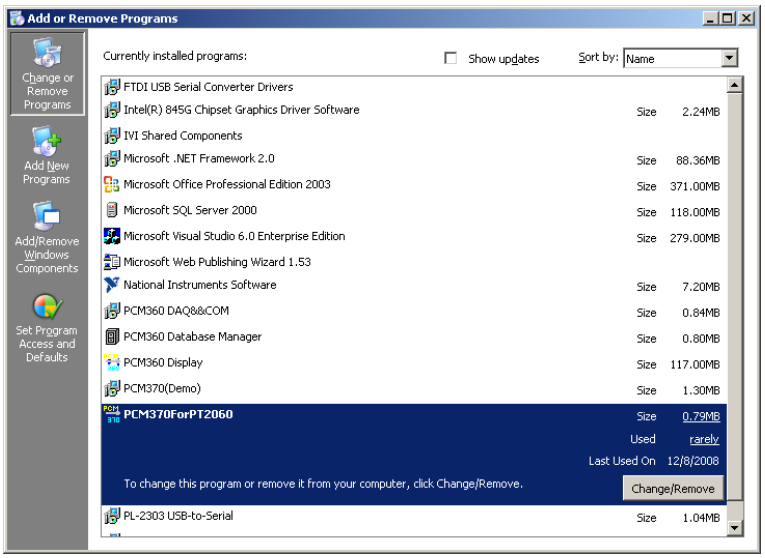


Uninstall PCM370ForPT2060 Software

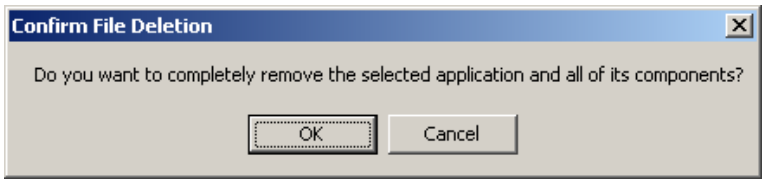
There are two methods for you to uninstall PCM370 System.

Method 1: Directly select **All Programs**, **PCM370ForPT2060**, **Uninstall**;

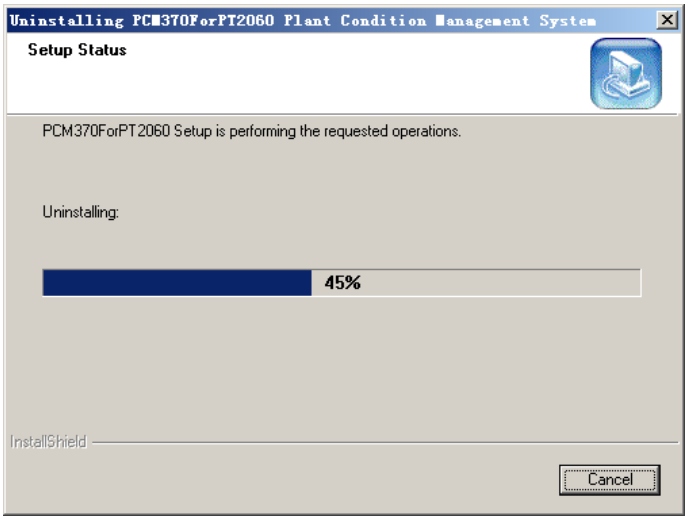
Method 2: Select **All Programs**, **Control Panel**, **Add or Remove Programs** to open the Add or Remove Programs window. Select **PCM370ForPT2060** in **Change or Remove Programs** tab, and click **Change/Remove** button.



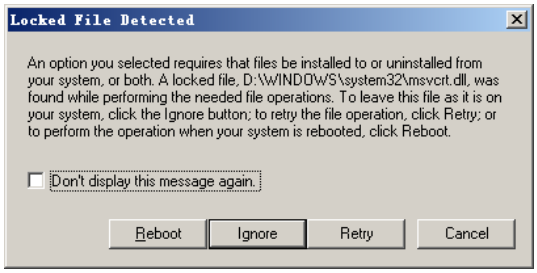
Click **OK** button in following picture:



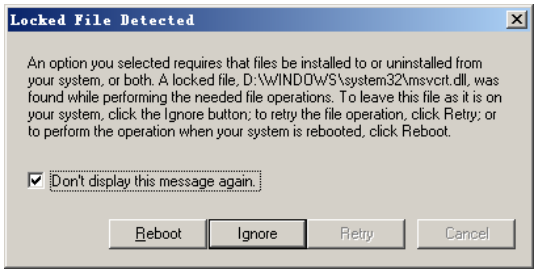
Show uninstalling status window:



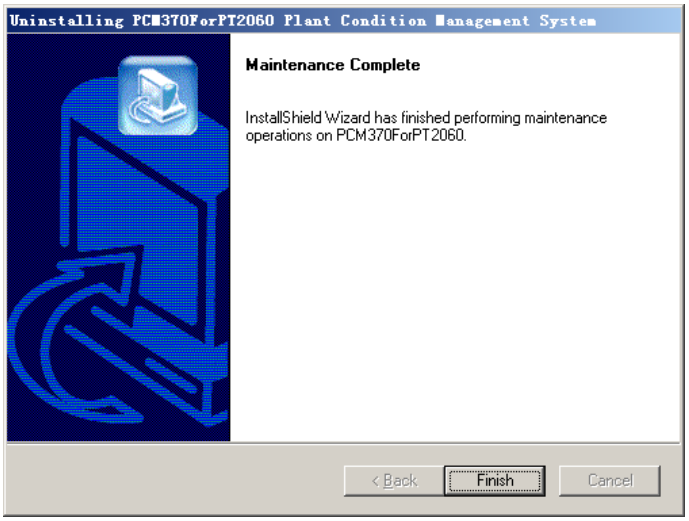
If you see **Locked File Detected** window in the process of copying files (see below picture), please check option of "Don't display this message again".


Locked File Detected
An option you selected requires that files be installed to or uninstalled from your system, or both. A locked file, D:\WINDOWS\system32\msvcrt.dll, was found while performing the needed file operations. To leave this file as it is on your system, click the Ignore button; to retry the file operation, click Retry; or to perform the operation when your system is rebooted, click Reboot.
Don't display this message again.
Reboot
Ignore
Retry
Cancel

And then click **Ignore** button. See below:


Locked File Detected
An option you selected requires that files be installed to or uninstalled from your system, or both. A locked file, D:\WINDOWS\system32\msvcrt.dll, was found while performing the needed file operations. To leave this file as it is on your system, click the Ignore button; to retry the file operation, click Retry; or to perform the operation when your system is rebooted, click Reboot.
Don't display this message again.
Reboot
Ignore
Retry
Cancel

Un-installation process completes. Click **Finish**.



PCM370ForPT2060 Software Operation

Run PCM370ForPT2060 software

CAUTION:

Before you run PCM370ForPT2060 software, please make sure that

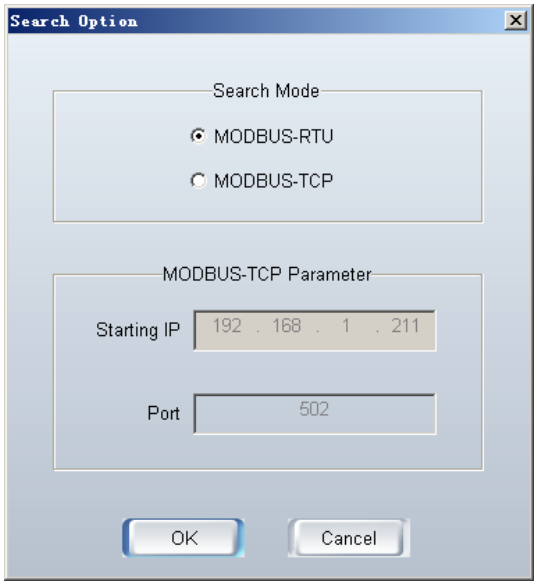
1. The PT2060 Racks have been correctly configured by PT2060-CFG software. You should pay attention to the following settings on PT2060 Racks.
   - **A. Rack Slave Address Setting:** Ensure the slave addresses of racks are in range from 1 to 5 and each slave address identifies a unique PT2060 Rack. You could refer to ***PT2060/91 SIM System Interface Module User Manual*** to get detailed information about Rack Slave Address Setting.
   - **B. Other communication parameters Setting:**
     - If the PT2060 Rack uses the Modbus RTU mode, the communication parameters for each PT2060 Rack should be set as:
       - ✓ **Baud Rate:** 19200
       - ✓ **Stop Bit:** 2
       - ✓ **Parity Bit:** None
     - If the PT2060 Rack uses MODBUS-TCP transmission mode, you should set the valid Rack IP Address for each rack. The format of IP Address is "A.B.C.D". A should be from 1 to 223 and can't be 127; B should be from 0 to 255; C should be from 0 to 255; D should be from 0 to 255. PCM370ForPT2060 software scans maximum ten consecutive IP addresses that begin with the Starting IP. **Make sure the "A.B.C" fields of Rack IP are the same as those of the host computer IP.** And we recommend that the racks in the system are set with the consecutive IP Addresses. For example: the computer IP is 192.168.1.1 and the system contains 5 PT2060 Racks. You could set the racks' IP as "192.168.1.100", "192.168.1.101", "192.168.1.102", "192.168.1.103" and "192.168.1.104" if the five IP addresses are not used yet.
2. The PT2060 Racks can communicate well with your PCM370ForPT2060 software and the device wirings are correct.

There are two methods for you to run PCM370ForPT2060 software:

Method 1: Select **Start**, **All Programs**, **PCM370ForPT2060**, **PCM370ForPT2060**;

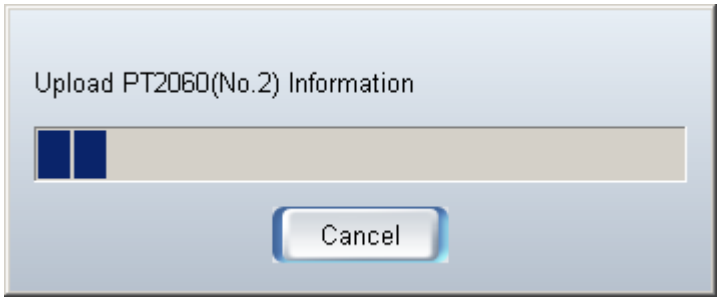
Method 2: Directly double-click shortcut icon of PCM370ForPT2060 on the desktop;

Condition 1: **The current database didn't record information about any PT2060 Racks.** For example, first time to start PCM370ForPT2060 software after the installation. In this condition, after you started PCM370ForPT2060 software, you will see following window.



In Search Option window, you should select the transmission mode of the system. If PT2060 Racks use MODBUS-RTU transmission mode, you should select MODBUS-RTU and then click OK button. If PT2060 Racks use MODBUS-TCP transmission mode, firstly you should select MODBUS-TCP, secondly type the minimum rack IP address in field of "Starting IP", thirdly type the valid port number in filed of "Port"(default value is 502), and finally click OK button.

After you finished the settings on Search Option window, click OK button. And then PCM370ForPT2060 software will scan the PT2060 Racks.



If the scanning succeeded, the information of all PT2060 Racks will be uploaded to PCM370ForPT2060 software.

Condition 2: The current database has recorded information about one or more PT2060 Racks. In this condition, PCM370ForPT2060 software will directly upload real time value and status from PT2060 Racks.

Device Bar

Device Bar displays the PT2060 Racks that are being monitored by PCM370ForPT2060 software. Each PT2060 Rack is described with “status light+PT2060+No.(Rack slave address)” that just looks like below picture:

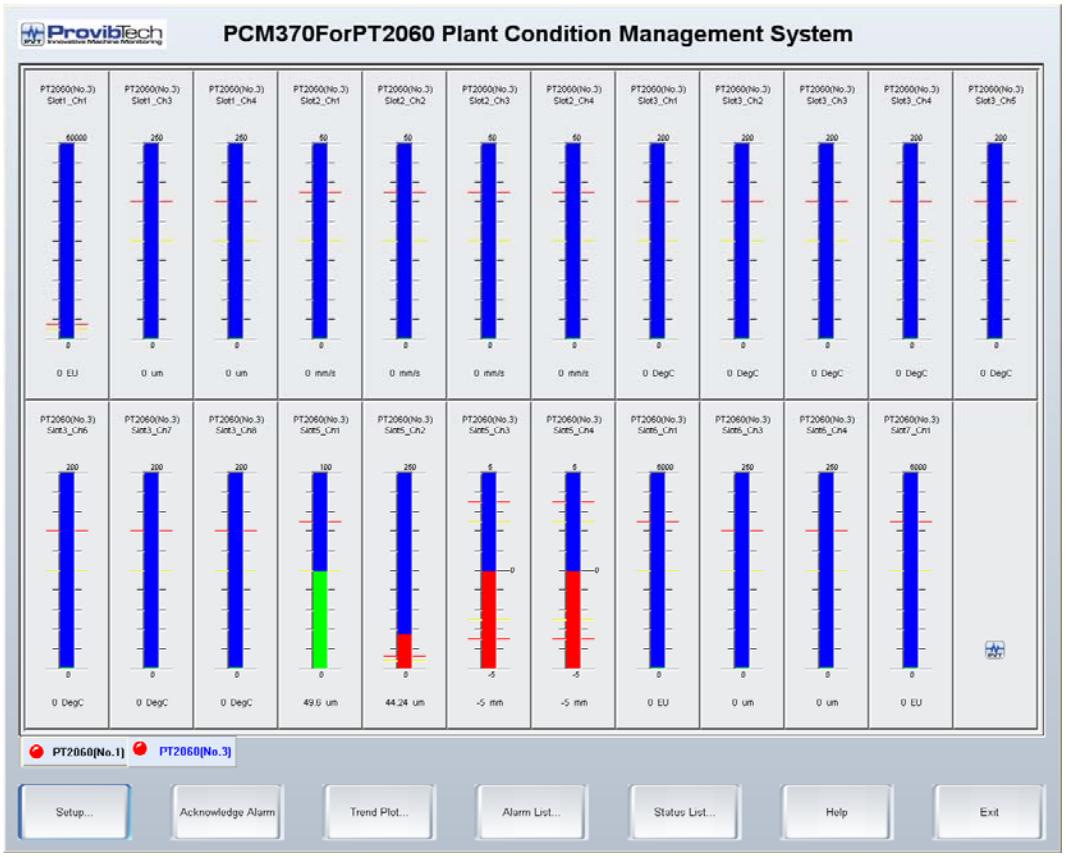
Clicking a PT2060 Rack from Device Bar, Bar Graph Tab will show bar graphs of channels under PT2060/10, PT2060/20, PT2060/30, and PT2060/53 modules of the selected PT2060 Rack.

NOTES:

1. The PCM370ForPT2060 software could monitor maximum 5 PT2060 Racks at the same time. And the total number of PT2060/10, PT2060/20, PT2060/30, and PT2060/53 modules in all PT2060 Racks should be less than or equal to 32.
2. Light color indication:
   - ✓ Green: Normal Status
   - ✓ Yellow: Alert Status
   - ✓ Red: Danger Status
   - ✓ Flashing: Alarm happened but hasn't been acknowledged.

Bar Graph

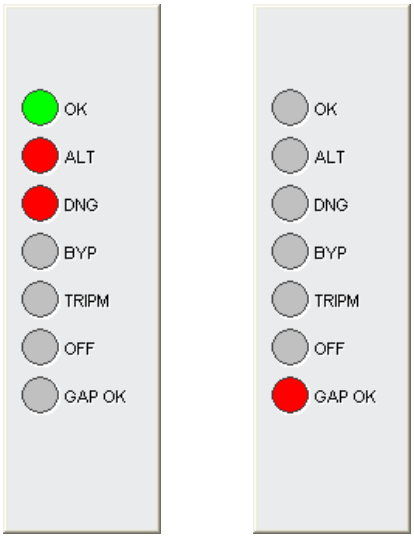
Clicking a PT2060 Rack from Device Bar, Bar Graph Tab will show bar graphs of channels under PT2060/10, PT2060/20, PT2060/30, and PT2060/53 modules of the selected PT2060 Rack. A bar graph page can have bar graph of maximum 24 channels. If the total channel number exceeds 24, you should go to other pages for additional bar graphs.



NOTES:

1. The name of each bar graph is described as PT2060 (No. ***Rack slave address***) Slot_Ch***Channel No.***
2. **Bar graph color indication:**
   - ✓ Green: Normal Status
   - ✓ Yellow: Alert Status
   - ✓ Red: Danger Status
   - ✓ Blue: Background color
   - ✓ Flashing: Alarm happened but hasn't been acknowledged.
3. **Channel Status Displaying**

   Left click a bar graph on the page and you will see channel status tab that looks like following picture:

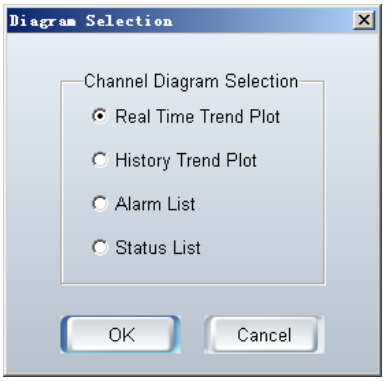


Following table show the color indication for each status bit.

Status Bit	Full Name	Light Color for Normal Status	Light Color for Abnormal Status
OK	OK	Green	Gray
ALT	Alert	Gray	Red
DNG	Danger	Gray	Red
BYP	Bypass	Gray	Red
TRPM	Triple Multiply	Gray	Red
OFF	OFF	Gray	Red
GAP OK	GAP OK	Gray	Red

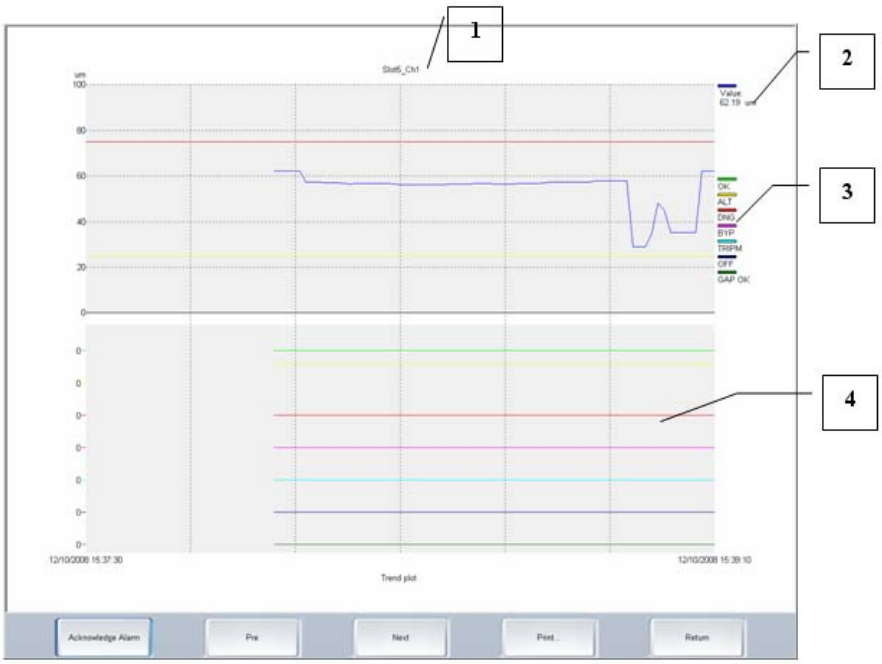
4. Other Plots and Lists Display

Double clicking will launch Diagram Selection window.



- ***View real time trend plot of the selected channel***

Check “Real Time Trend Plot” and then click OK. Following picture shows you the real time trend plot window of the selected channel.



i. "1" shows the title of the trend plot. It is described as slot**No.**_Ch**Channel No.**

ii. "2" shows the real time measure value of the selected channel. It also shows the color indication of the channel's trend plot.

iii. "3" shows the color indication for each status bit.

iv. "4" shows the trend plot of the status bits.

v. Red line on the upside shows danger set point; yellow line shows alert set point; blue line shows measure value of this channel.

vi. **Acknowledge Confirm:** Click it to acknowledge the alarm.

vii. **Pre:** Click it to view real time trend plot of the previous channel. If the current channel is the first channel, this button will be disabled.

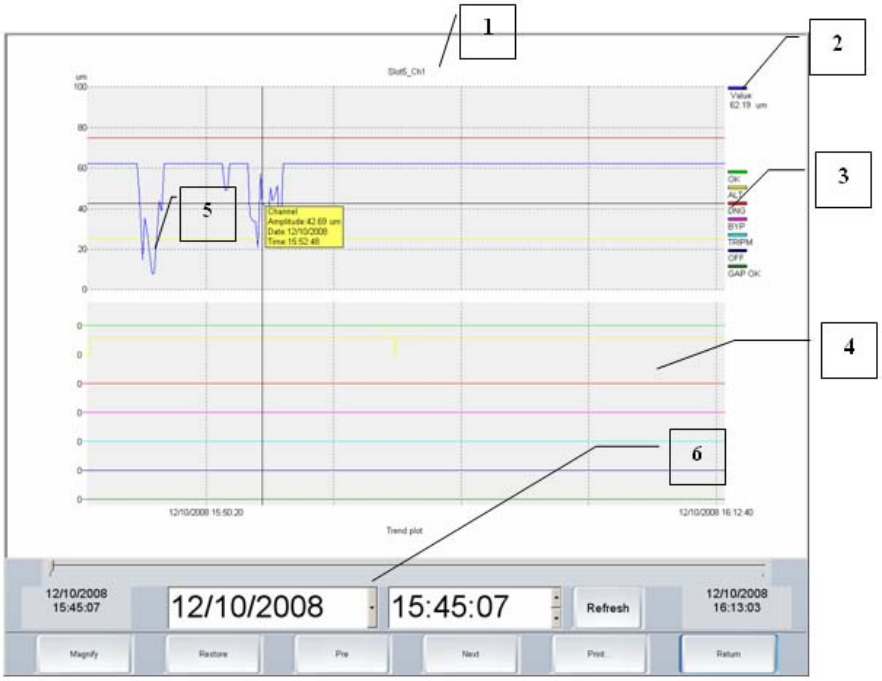
viii. **Next:** Click it to view real time trend plot of the next channel. If the current channel is the last channel, this button will be disabled.

ix. **Print:** Click it to print the current trend plot window.

x. **Return:** Click it to back to the bar graph window.

- ***View history trend plot of the selected channel***

Check "History Trend Plot" and then click OK button. Following picture shows you the history trend plot window of the selected channel.



i. "1" shows the title of the trend plot. It is described as slot**No.**_Ch**Channel No.**

ii. "2" shows the measure value of the last sample on the current trend plot and color indication for the channel's measure value.

iii. "3" shows the color indication for measure value of each status bit.

iv. "4" shows the trend plot for each status bit. When the bit returns 0, the bit is in normal; and when the bit returns 1, the bit is in abnormal.

v. The yellow rectangle displays the measure value and collected time of the selected sample on the trend plot.

vi. "5" shows the history trend plot of the selected channel.

vii. "6" shows time slider, date picker, time picker and Refresh button. You can use the time slider to change the starting time of trend plot. Also you can use date picker and time picker to change the starting time of trend plot. After you changed the date and time, you should click "Refresh" button to refresh the data and time on the current trend plot window.

viii. **Magnify:** It is used to zoom in the trend plot. Click this button and drag a rectangle, the plot in this rectangle will be magnified.

ix. **Restore:** Click it to restore the magnified plot to original size.

x. **Pre:** Click it to view history trend plot of the previous channel. If the current channel is the first channel, this button will be disabled.

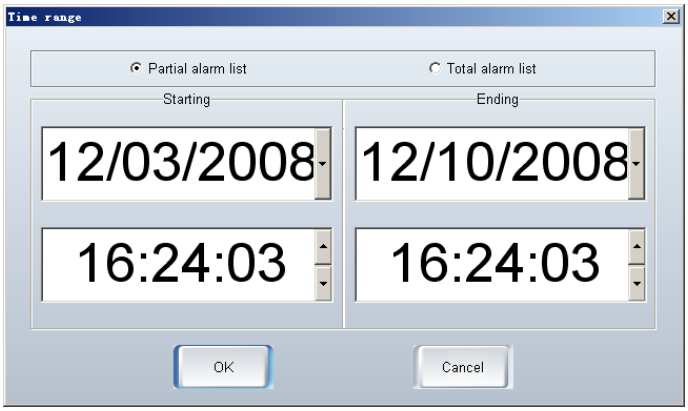
xi. **Next:** Click it to view history trend plot of the next channel. If the current channel is the last channel, this button will be disabled.

xii. **Print:** Click it to print the current trend plot window.

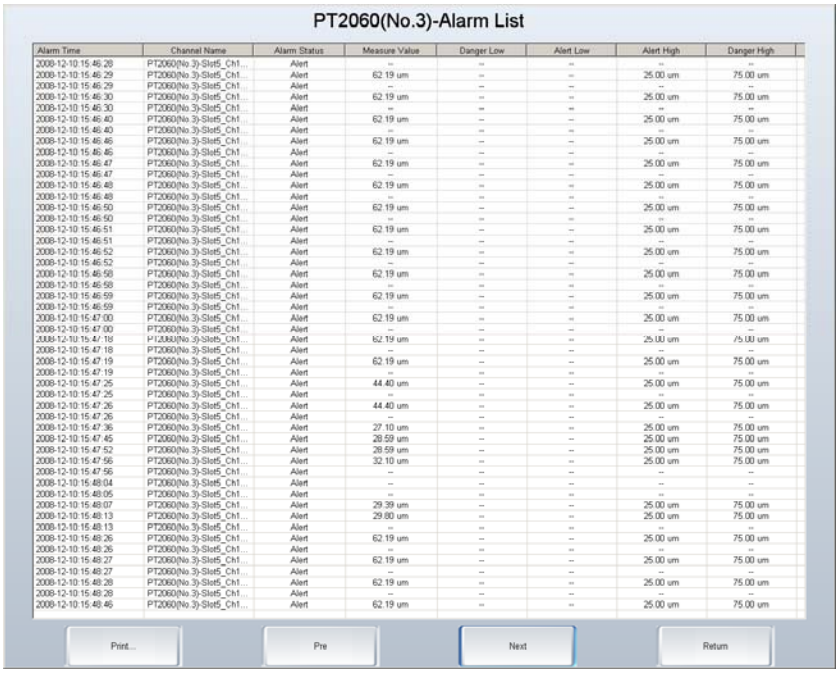
xiii. **Return:** Click it to back to the bar graph window.

- ***View alarm list of the selected channel***

Check “Alarm List” and then click OK button. Time range window is launched. In this window, you can select the time range in which the channel’s alarm events happened. If you want to view all alarm events under the selected channel, you should check "Total alarm list" and then click OK button. If you want to view alarm events in certain time range, you should check "Partial alarm list", and set the start time and ending time, and finally click OK button.



Following picture shows you the total alarm list of Slot5_Ch1.



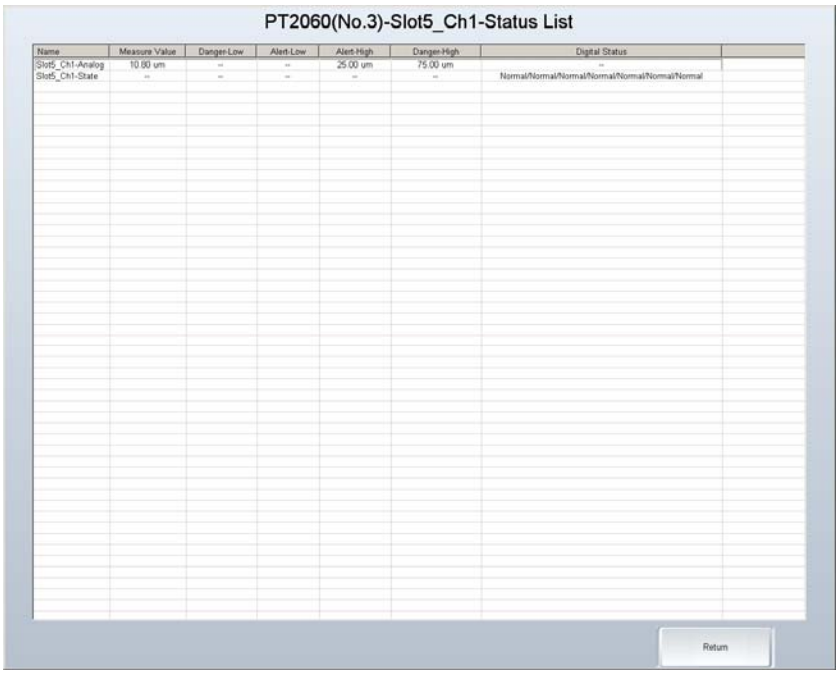
i. Each alarm list page can display maximum 50 alarm events. If the alarm events number exceeds 50, you could go to other pages for more alarm events by clicking “Pre” and “Next” button.

ii. **Print:** Click this button to print the current alarm list window.

iii. **Return:** Click this button to back to the bar graph window.

- ***View status list of the selected channel***

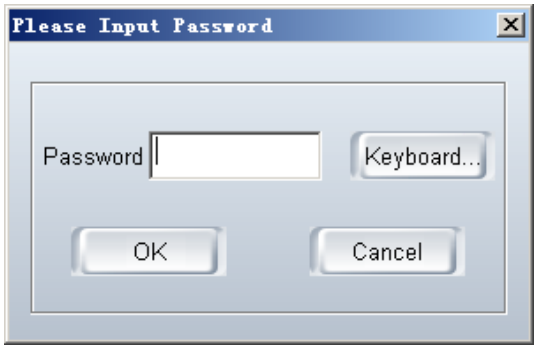
Check “Status List” and then click OK button. Following picture shows you the status list of Slot5_Ch1.



Status list show the channel’s real time measure value and status.

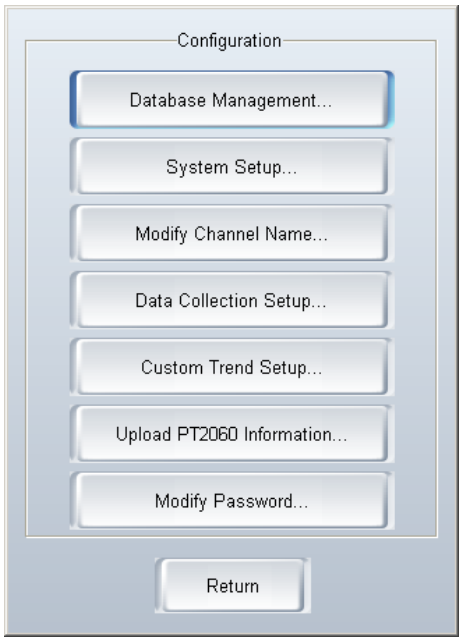
Setup

Click Setup button on the main window. You will be asked to enter the password. Default password is “password”.



Keyboard button: Clicking this button will open On-Screen Keyboard window. You are strongly recommended that do not close this window when PCM370ForPT2060 software is in configuration status.

Click OK button after you entered the correct password. Below is the configuration window.



NOTE:

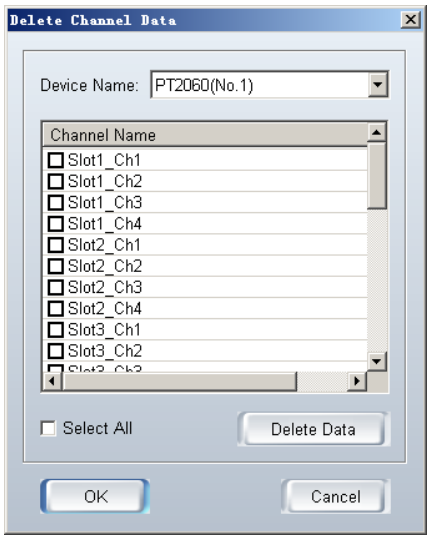
PCM370ForPT2060 software stops data collection when it is in configuration state.

Database Management

Click Database Management button on configuration window to open DB Management window.

Delete Channel Data…button:

Click this button to open Delete Channel Data window. In this window, you can delete one or more channels' data.

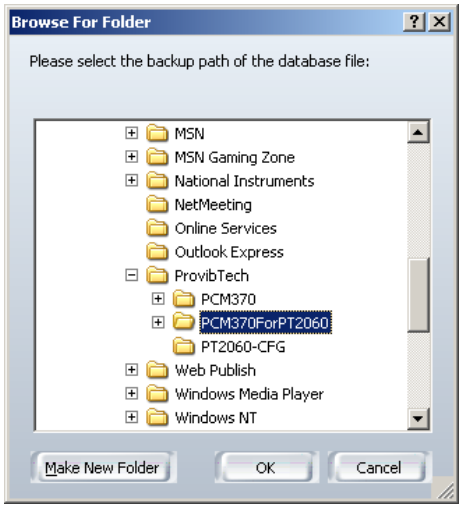


Select a PT2060 Rack from Device Name list. Check the name of the channel of which data you want to delete and then click Delete Data button to delete the selected channels' data.

If you want to delete all channels' data, you can directly check "Select All" and then click Delete Data button.

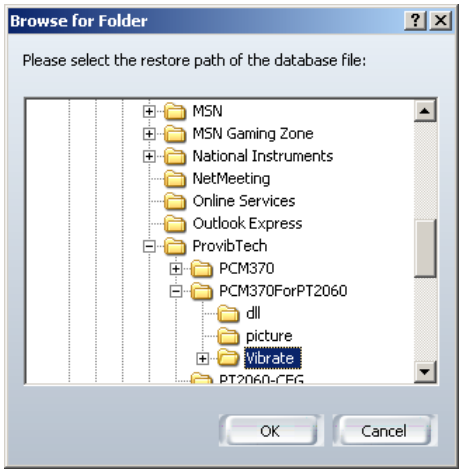
Backup Database…button

Use this command to backup the current database. Click Backup Database button and then select a backup path. If you select the path "C:\PCM370ForPT2060", the database will be saved as "C:\PCM370ForPT2060\vibrate".



Restore Database…button

Use this command to restore the current database to a backup database. Click Restore Database button and then select the path of the backup database.



If the database file is saved under path of "C:\PCM370ForPT2060", you should select the path of "C:\PCM370ForPT2060\vibrate".

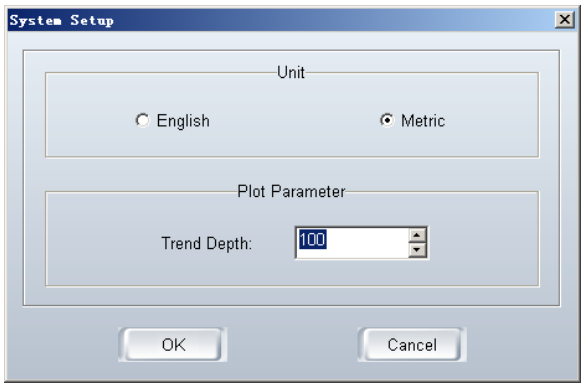
Clear Database…button

Use this command to empty the current database. Click Clear Database button and CAUTION window is launched.

All data even the rack information will be removed after the operation. If you are sure to clear database, you should click Yes button.

System Setup

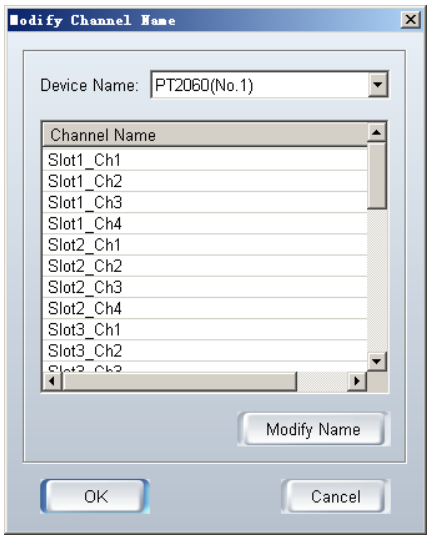
Click System Setup button on configuration window to open System Setup window. In System Setup Window you can set unit and trend depth.



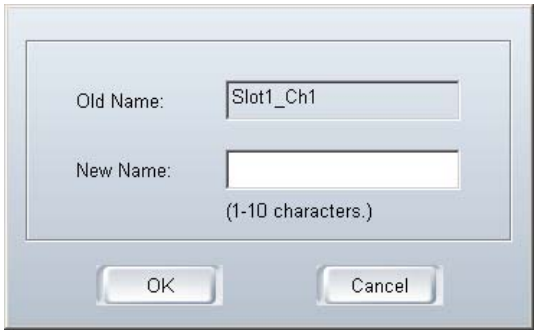
Trend depth is the maximum number of the points to generate a trend plot. The maximum value is 2000.

Modify Channel Name

Click Modify Channel Name button on configuration window to open Modify Channel Name window. In Modify Channel Name Window, you can change the channel's name.



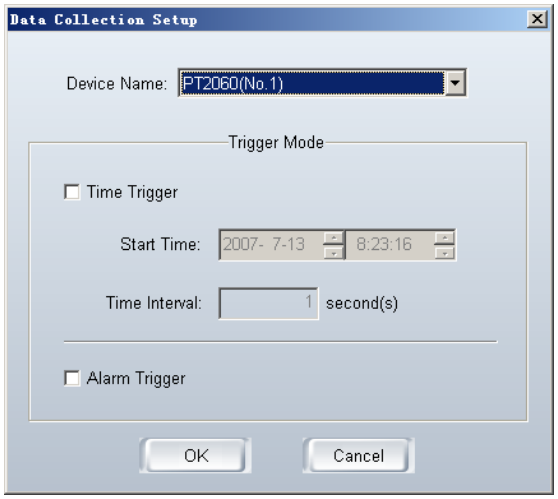
Select a PT2060 Rack from Device Name list and select a channel under this PT2060 Rack, and then click Modify Name button.



Enter the new name in the edit box and click OK button. The maximum length of the channel number is 10 characters.

Data Collection Setup

Click Data Collection Setup button on configuration window to open Data Collection Setup window.

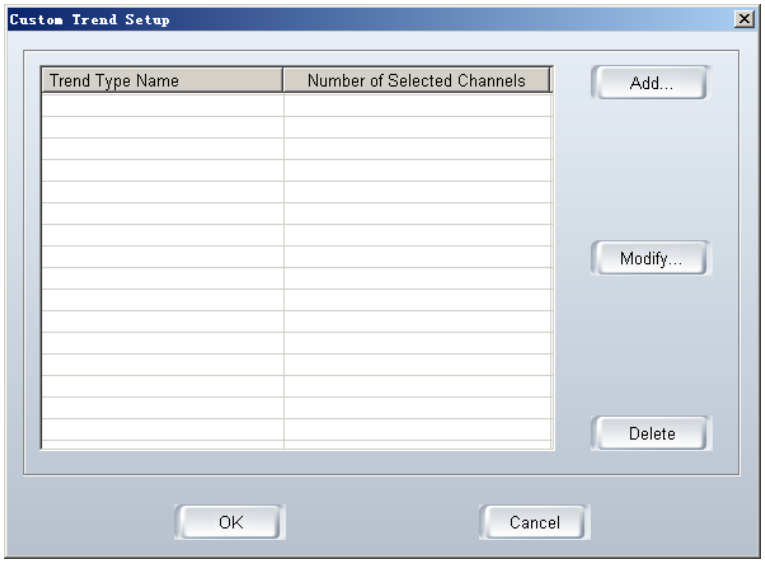


In this window, you can set data collection condition for each PT2060 Rack.

- **Time Trigger:** Check it to set time trigger condition. Please select start time and enter the time interval.
- **Alarm Trigger:** If you check this option, the PT2060 Rack will be triggered when a channel under this PT2060 Rack alarms. When first alarm happens, PCM370ForPT2060 software will automatically collect all channels' data under the selected PT2060 Rack. When alarm happens, you are strongly recommended to click Acknowledge Alarm button to acknowledge the alarm event. If you don't acknowledge the alarm this time, and when the alarm happens next time, PCM370ForPT2060 software won't collect the data.

Custom Trend Setup

Click Custom Trend Setup button on configuration window to open Custom Trend Setup window. Custom Trend Setup Window is used to set the custom trend plot type. With this function, you can view trend plots of several channels on a window. This function helps you compare data from different channels.



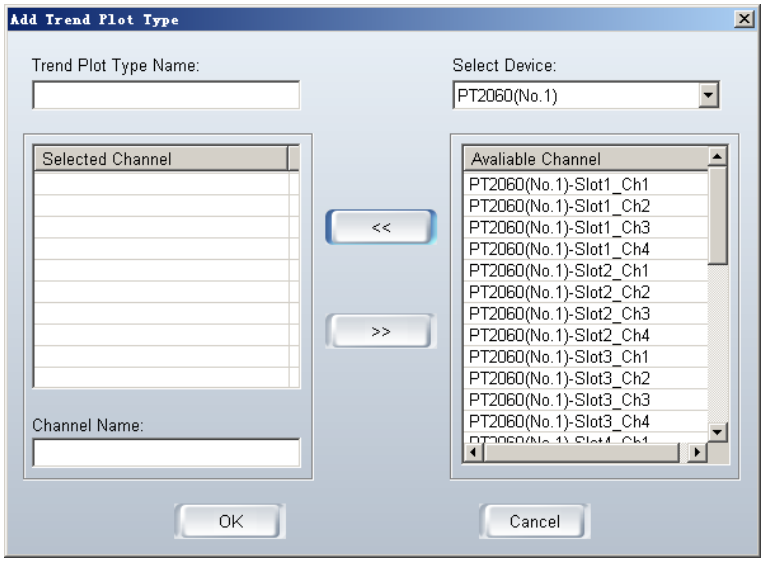
Trend Type Name: Display the name of a custom trend type.

Number of Selected Channels: Display total number of the channels that are contained in a custom trend type.

Add...button

Click this button to add a new custom trend type.

NOTE: Maximum 8 custom trend plot types can be added. Each custom trend plot type can contain maximum 16 channels.



Select Device: Display the PT2060 Racks that are monitored by PCM370ForPT2060 software.

Available Channel: If you select a PT2060 Rack, all channels under this rack are displayed.

<<: Left shift button.

>>: Right shift button.

Trend Plot Type Name: In this field, you should enter the name for the new custom trend type. Maximum length of the custom trend type name is 31 characters.

Selected Channel: This field lists the selected channels.

Channel Name: You can change the name of the selected channel in this field by clicking the channel in Selected Channel List. If you select a channel from Available Channel list and click << to move it to Selected Channel, the full name of the selected channel will be displayed in this field. Maximum length of the channel name is 9 characters. If the channel name length exceeds 9 characters, PCM370ForPT2060 will automatically throw off the part that exceeds 9 characters and save the anterior 9 characters as the channel name.

Example to add a new trend plot type

Step1: Select the PT2060 Rack.

Step2: Select the channel in the Available Channel list and click << to add this channel to Selected Channel list. You can change the name in edit box of "Channel Name". You should control the length of the channel name in 9 characters.

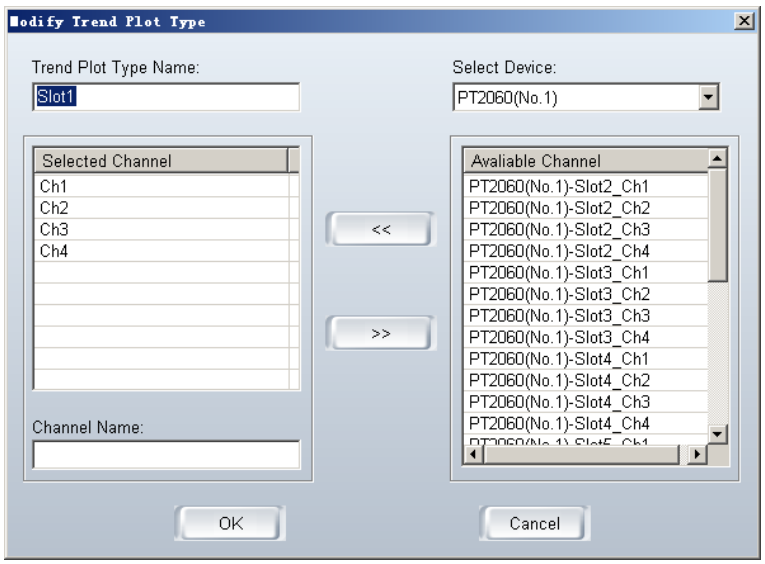
Step3: Repeat Step1 and Step2 until you add all the channels you want.

Step4: Enter the name for the new custom trend plot type in edit box of "Trend Plot Type".

Step5: Click OK.

Modify...button

Select the custom trend plot type in Custom Trend Setup window and then click Modify...button.



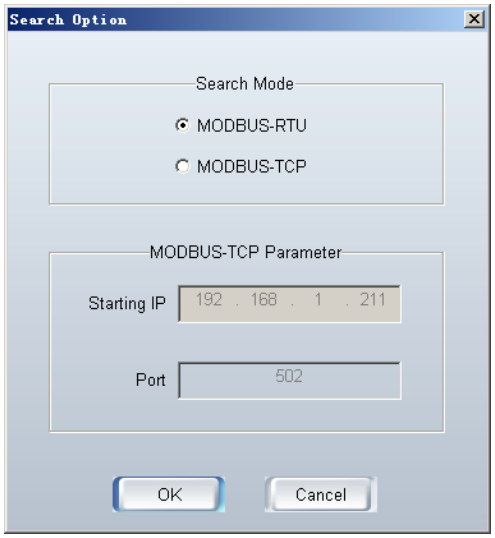
In the window, you can change the name of this custom trend plot type. And you can change the name of the channels contained in the current custom trend plot type. Also you can change the channel member in the custom trend plot type: adding new channels or deleting some channels.

Delete...button

Select the custom trend plot type in Custom Trend Setup window and then click Delete...button. If you are sure to delete the selected trend plot type, please click Yes on the below window.

Upload PT2060 Information

Click Upload PT2060 Information button on configuration window. Search Option window is launched. In this window, you can change the communication parameters. After the parameters' setting, PCM370ForPT2060 software will upload the information from PT2060 Racks.



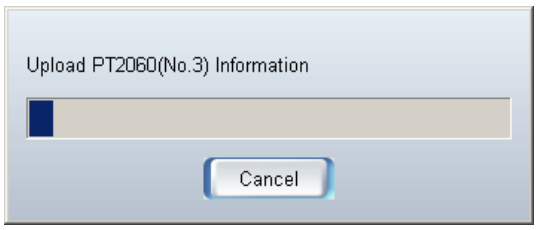
If PT2060 Racks use MODBUS-RTU transmission mode, you should select MODBUS-RTU. The communication parameters of PT2060 Racks should be set as follows:

- ✓ **Baud Rate:** 19200
- ✓ **Stop Bit:** 2
- ✓ **Parity Bit:** None

If PT2060 Racks use MODBUS-TCP transmission mode, you should select MODBUS-TCP. And also enter the Starting IP and Port in related edit box.

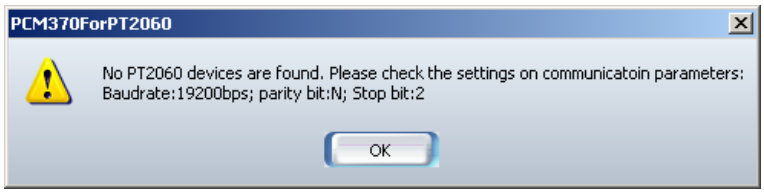
- ✓ **Starting IP:** You should enter the starting IP address of the PT2060 Racks. This address is a string of 4 numbers. The address format is "A.B.C.D". A should be from 1 to 223 and can't be 127; B should be from 0 to 255; C should be from 0 to 255; D should be from 0 to 255. PCM370ForPT2060 software will automatically scan the maximum 10 consecutive valid IP addresses that begin with the starting IP. **Make sure the "A.B.C" fields of Rack IP are the same as those of the host computer IP.** ***For example:*** 5 PT2060 Racks in the system all use MODBUS-TCP transmission mode. The IP address of the PT2060 Racks are "192.168.1.100", "192.168.1.101", "192.168.1.102", "192.168.1.103", and "192.168.1.104". So you should enter "192.168.1.100" in field of "Starting IP".
- ✓ **Port:** Default value is 502.

Click OK button on Search Option window after the setting, and then PCM370ForPT2060 will upload information of the PT2060 Racks.

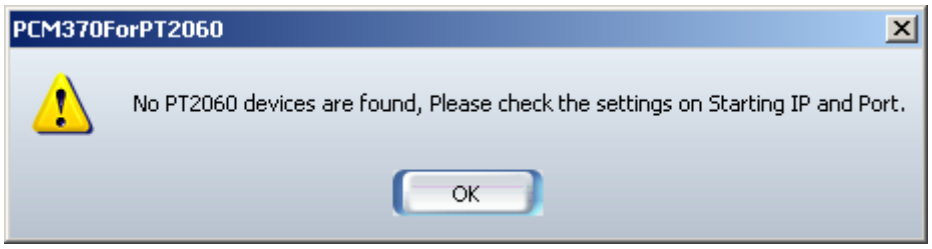


NOTES:

1. When the PT2060 Racks use MODBUS-RTU transmission mode and PCM370ForPT2060 can't scan any PT2060 Racks, you will see following window:


PCM370ForPT2060
No PT2060 devices are found. Please check the settings on communicatoin parameters:
Baudrate:19200bps; parity bit:N; Stop bit:2
OK

2. When the PT2060 Racks use MODBUS-TCP transmission mode and PCM370ForPT2060 can't scan any PT2060 Racks, you will see following window:



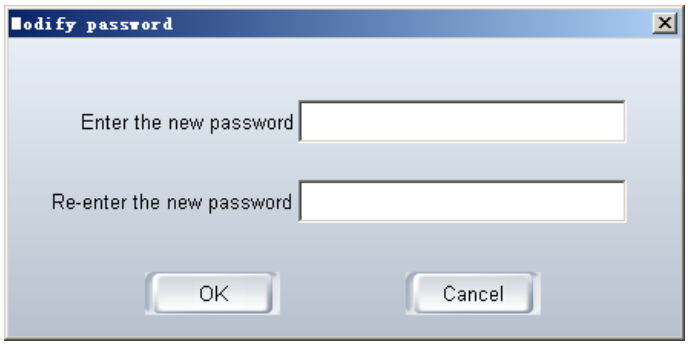
3. When PCM370ForPT2060 find the PT2060 Racks by the two transmission modes and the uploading fails due to some error, you will see following window:

4. When the uploading succeeded, you will see following window:

5. If the information in PT2060 Racks is changed, you should re-upload the rack information.

Modify Password

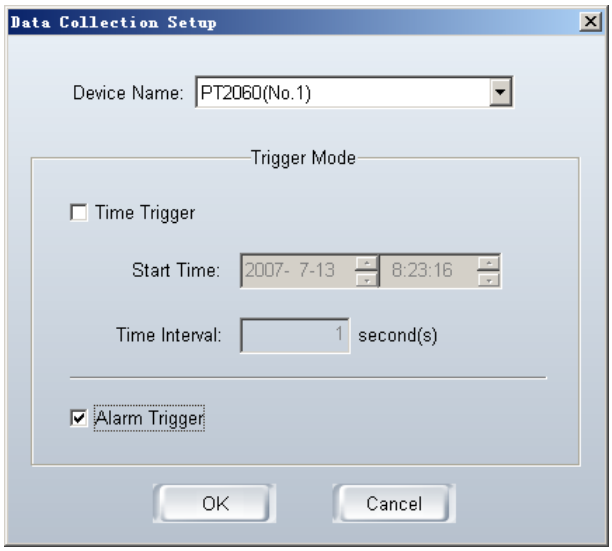
Click Modify Password button on configuration window to open Modify password window. You can change the password in this window. Enter the new password in the edit boxes twice and then click OK button.



NOTE: Maximum password length is 31 characters.

Acknowledge Alarm

NOTE: Acknowledge Alarm command has only effect on the PT2060 Racks that are set "Alarm Trigger" on Data Collection Setup window below:

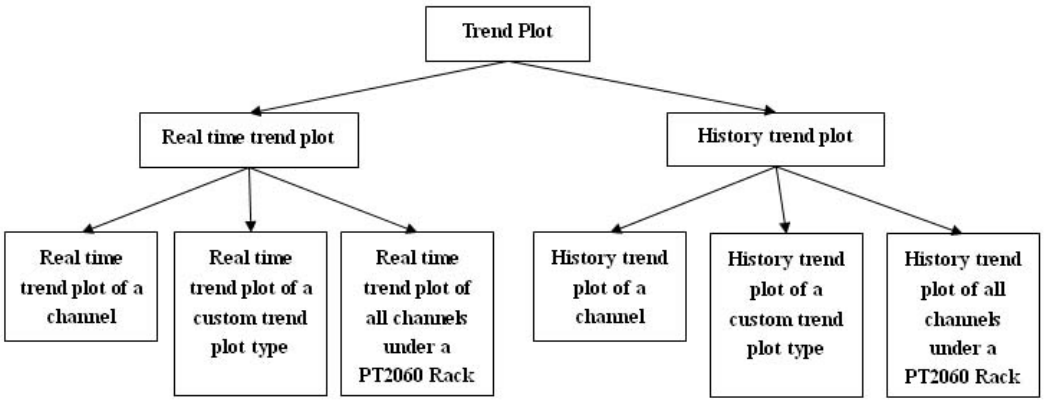


Acknowledge Alarm command is used to acknowledge the alarm event. You could see this button on two types of windows in PCM370ForPT2060 software. They are the main window and the real time trend plot window. Acknowledge Alarm buttons on the two types of windows do the same work. When the PT2060 Rack with the "Alarm Trigger" property set alarms at the first time, PCM370ForPT2060 software will automatically collect the data. You must click Acknowledge Alarm button to acknowledge the alarm event. Because if you don't acknowledge the alarm, when the alarm happens next time, PCM370ForPT2060 software will not collect the data.

If the un-acknowledged alarm exists, the light color before the alarmed PT2060 Rack or the bar graph of the alarmed channel will keep flashing.

Trend Plot

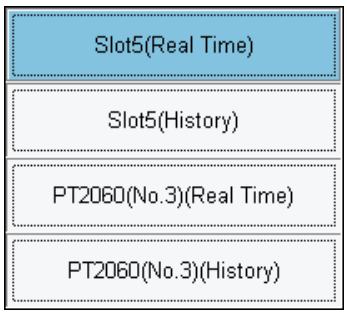
PCM370ForPT2060 software displays two types of trend plots: real time trend plot and history trend plot. Moreover, PCM370ForPT2060 software supports displaying trend plot of a single channel, a custom trend plot type, and all channels under a PT2060 Rack. Following figure shows you the detailed classification of the trend plot.


Trend Plot
Real time trend plot
History trend plot
Real time trend plot of a channel
Real time trend plot of a custom trend plot type
Real time trend plot of all channels under a PT2060 Rack
History trend plot of a channel
History trend plot of a custom trend plot type
History trend plot of all channels under a PT2060 Rack

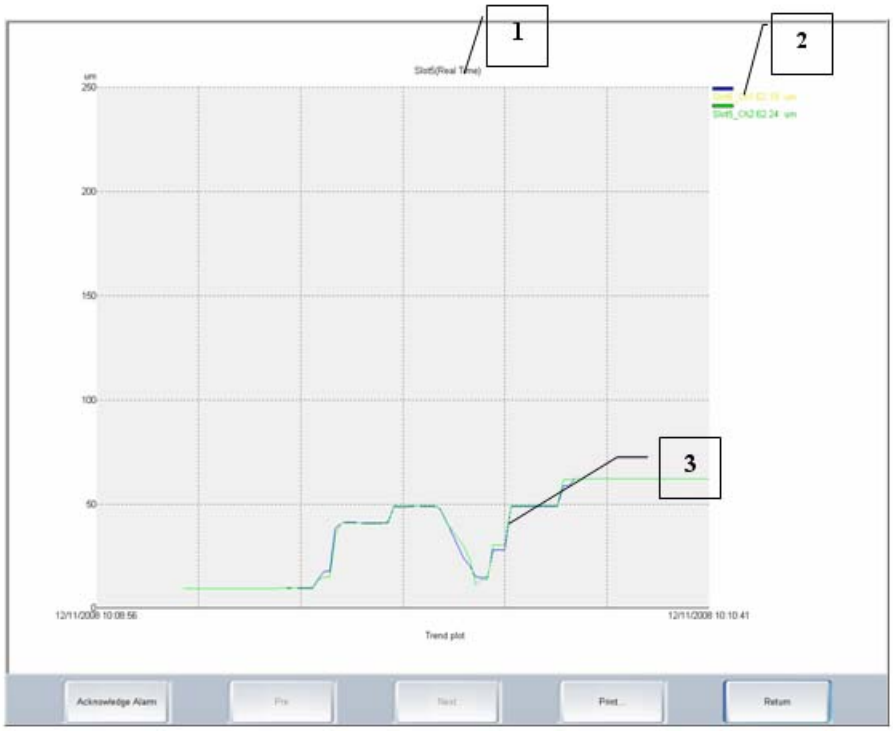
For more details about real time trend plot and history trend plot of the single channel, you could refer to chapter of Bar Graph.

- **View real time trend plot of a custom trend plot type**

Directly click Trend Plot on the main window, and a menu pops up. The custom trend plot types that have been defined on Custom Trend Setup window are listed on the menu.



For example, we have defined a custom trend plot type that is named “Slot5” and you should select “Slot5(Real Time)” from the list. The real time trend plot window of the custom trend plot type “Slot5” is below:

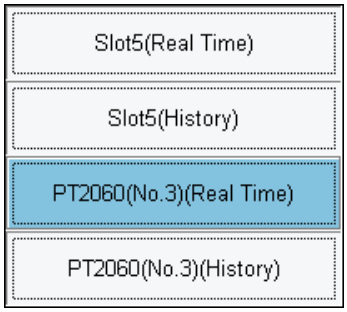


NOTES:

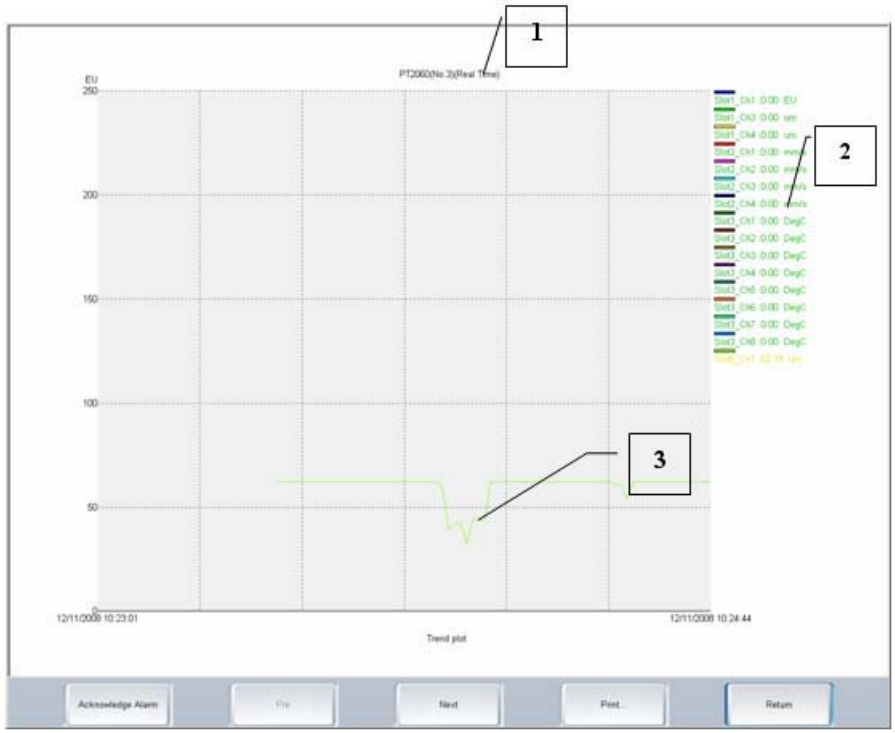
1. "1" shows the title of the trend plot. It is described as "**custom trend type name**(Real Time)".
2. "2" shows the real time measure value of the channels that are contained in the selected custom trend type. It also shows the color indication of the channels' trend plot. When a channel is in alert status, the color of the measure value will display yellow; when a channel is in danger status, the color of the measure value will display red; when there existed the un-acknowledged alarm in a channel, the channel's measure value will keep flashing.
3. "3" shows the real time trend plot of the channels that are contained in the selected custom trend type.
4. **Acknowledge Confirm:** Click it to acknowledge the alarm.
5. **Print:** Click it to print the current trend plot window.
6. **Return:** Click it to back to the main window.

- **View real time trend plot of all channels under a PT2060 Rack**

Select a PT2060 Rack for example PT2060(No.3) on the Device Bar. Click Trend Plot on the main window and a menu pops up.



For example, you select PT2060(No.3)(Real Time) from the list. The real time trend plot window of the selected PT2060(No.3) is below:

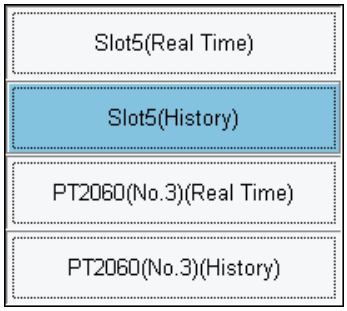


NOTES:

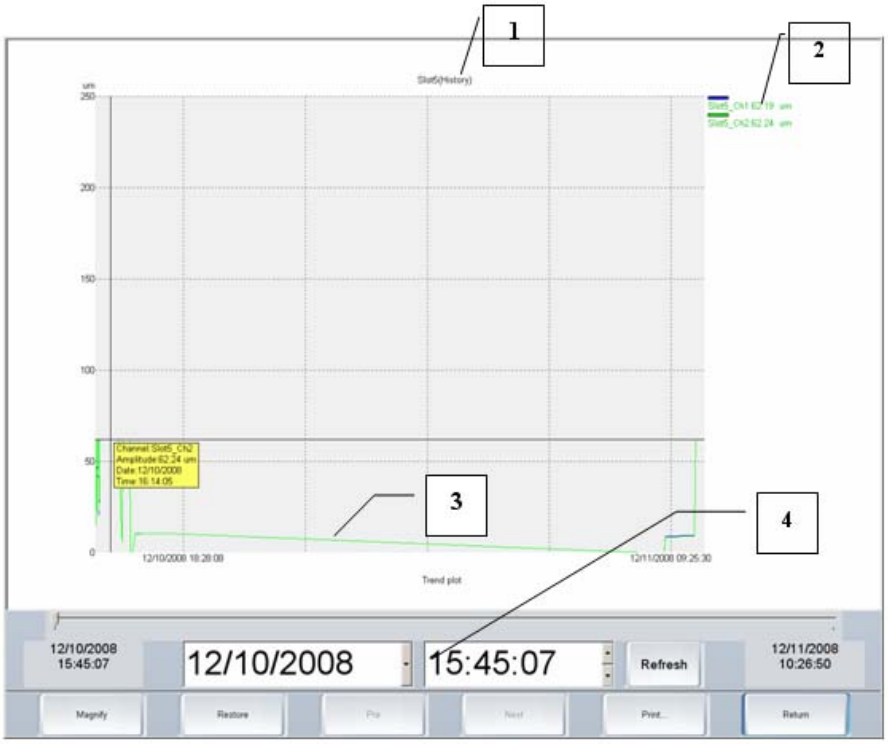
1. "1" shows the title of the trend plot. It is described as "PT2060(No.**rack salve address**)(Real Time)".
2. "2" shows the real time measure value of the channels under the selected PT2060 Rack. It also shows the color indication of the channels' trend plot. When a channel is in alert status, the color of the measure value will display yellow; when a channel is in danger status, the color of the measure value will display red; when there existed the un-acknowledged alarm in a channel, the channel's measure value will keep flashing.
3. "3" shows the real time trend plot of the channels under the selected PT2060 Rack.
4. **Acknowledge Confirm:** Click it to acknowledge the alarm.
5. **Pre button and Next button:** A page can display maximum 16 channels' trend plot. If the total channel number exceeds 16, you can use Pre button and Next button to go to other pages for additional channels' trend plot.
6. **Print:** Click it to print the current trend plot window.
7. **Return:** Click it to back to the main window.

- **View history trend plot of a custom trend plot type**

Directly click Trend Plot on the main window, and a menu pops up. The custom trend plot types that have been defined on Custom Trend Setup window are listed on the menu.



For example, we have defined a custom trend plot type that is named “Slot5” and you should select “Slot5(History)” from the list. The real time trend plot window of the custom trend plot type “Slot5” is below:



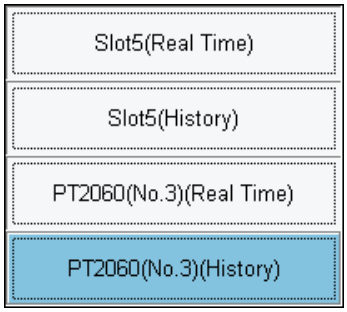
NOTES:

1. “1” shows the title of the trend plot. It is described as “**custom trend type name**(History)”.
2. “2” shows the last sample’s measure value of the channels that are contained in the selected custom trend type. It also shows the color indication of the channels’ trend plot.
3. “3” shows the history trend plot of the channels that are contained in the selected custom trend type.
4. The yellow rectangle displays the measure value and collected time of the selected sample on the trend plot.
5. “4” shows time slider, date picker, time picker and Refresh button. You can use the time slider to change the starting time range of trend plots. Also you can use date picker and time picker to change the starting time of trend plot. After you change the date and time, you should click “Refresh” button to refresh the data and time on the trend plot window.

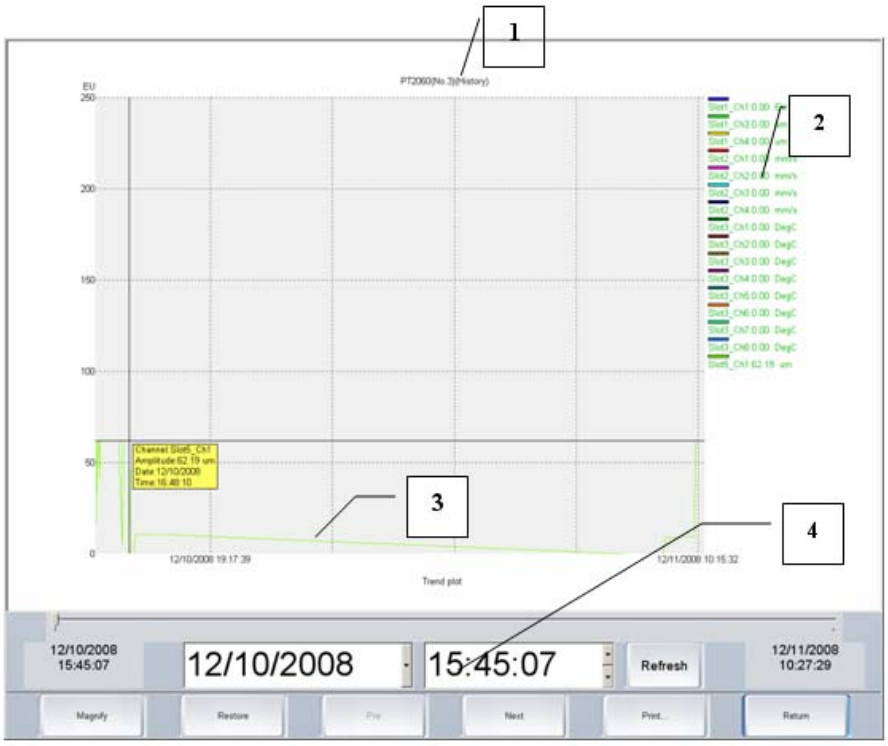
6. **Magnify:** It is used to zoom in the trend plot. Click this button and drag a rectangle, the plot in this rectangle will be magnified.
7. **Restore:** Click it to restore the magnified plot to original size.
8. **Print:** Click it to print the current trend plot window.
9. **Return:** Click it to back to the main window.

- **View history trend plot of all channels under a PT2060 Rack**

Select a PT2060 Rack for example PT2060(No.3) on the Device Bar. Click Trend Plot on the main window and a menu pops up.



For example, you select PT2060(No.3)(History) from the list. The history trend plot window of the selected PT2060(No.3) is below:



NOTES:

1. "1" shows the title of the trend plot. It is described as "PT2060(No.**rack salve address**) (History)".

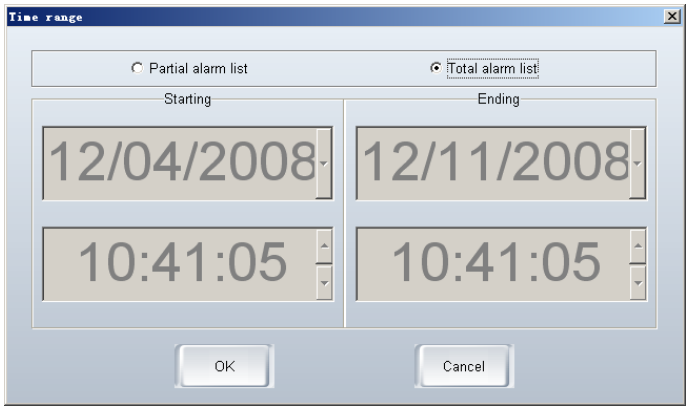
2. “2” shows the last sample’s measure value of the channels under the selected PT2060 Rack. It also shows the color indication of the channels’ trend plot.
3. “3” shows the history trend plot of the channels under the selected PT2060 Rack.
4. The yellow rectangle displays the measure value and collected time of the selected sample on the trend plot.
5. “4” shows time slider, date picker, time picker and Refresh button. You can use the time slider to change the starting time range of trend plots. Also you can use date picker and time picker to change the starting time of trend plot. After you change the date and time, you should click “Refresh” button to refresh the data and time on the trend plot window.
6. **Magnify:** It is used to zoom in the trend plot. Click this button and drag a rectangle, the plot in this rectangle will be magnified.
7. **Restore:** Click it to restore the magnified plot to original size.
8. **Pre button and Next button:** A page can display maximum 16 channels’ history trend plot. If the total channel number exceeds 16, you can use Pre button and Next button to go to other pages for additional channels’ trend plot.
9. **Print:** Click it to print the current trend plot window.
10. **Return:** Click it to back to the main window.

Alarm List

PCM370ForPT2060 software display two types of alarm list: alarm list of a single channel and alarm list of a PT2060 Rack. For more details about alarm list of the single channel, you could refer to chapter of Bar Graph.

View alarm list of a PT2060 Rack

Select the PT2060 Rack from Device Bar and then click Alarm List button on main window. Time range window is launched. In this window, you can select the time range in which the selected PT2060 Rack's alarm events happened. If you want to view all alarm events under the selected PT2060 Rack, you should check "Total alarm list" and then click OK button. If you want o view alarm events in certain time range, you should check "Partial alarm list", and set the start time and ending time, and finally click OK button.



Following picture shows you the total alarm list of PT2060(No.3).

NOTES:

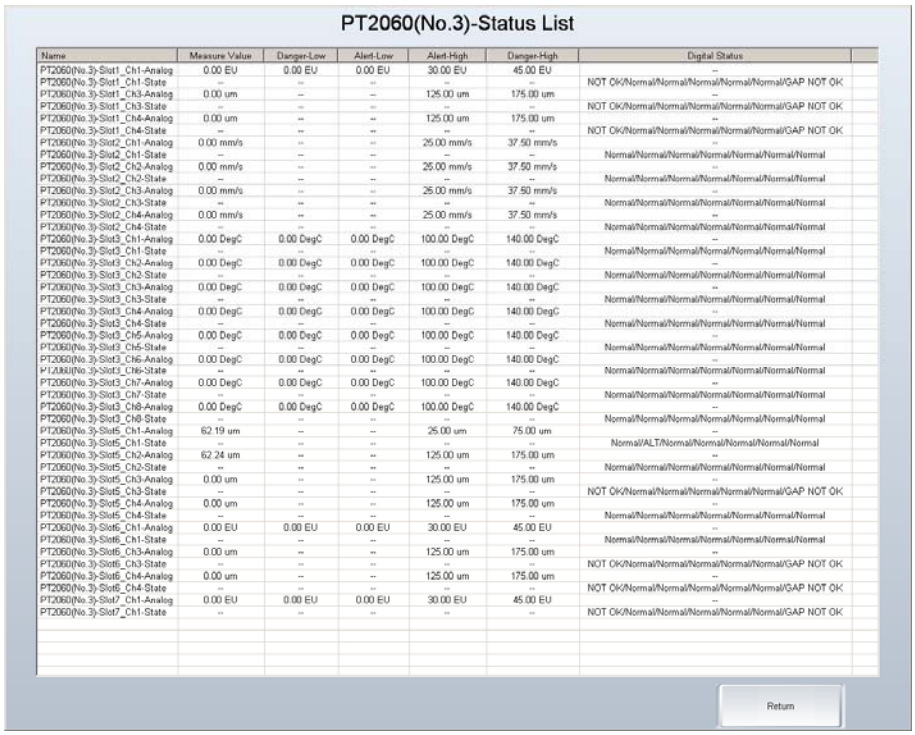
1. Each alarm list page can display maximum 50 alarm events. If the alarm events number exceeds 50, you could go to other pages for more alarm events by clicking “Pre” and “Next” button.
2. **Print:** click this button to print the current alarm list window.
3. **Return:** click this button to back to the bar graph window.

Status List

PCM370ForPT2060 software display two types of status list: status list of a single channel and status list of a PT2060 Rack. For more details about status list of the single channel, you could refer to chapter of Bar Graph.

View status list of a PT2060 Rack

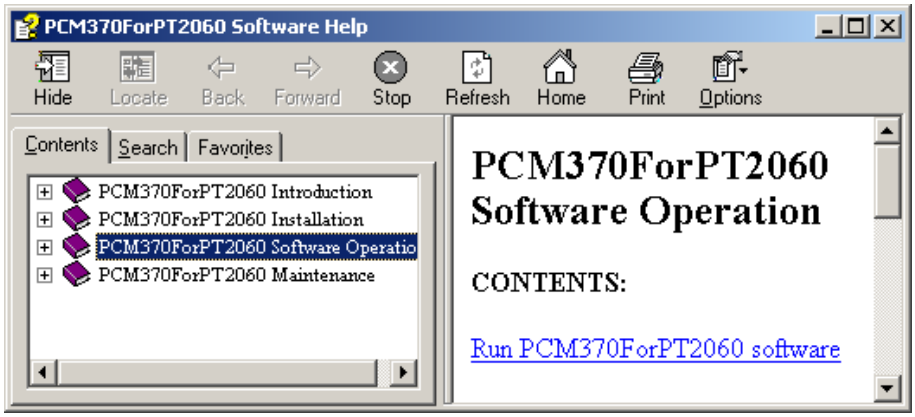
Select the PT2060 Rack from Device Bar and then click Status List button on main window. Following picture shows you the status list of the selected PT2060 Rack.



Status list show measure value and status of all channels under the selected PT2060 Rack.

Help

Click Help on main window or press F1 on keyboard to view help file of PCM370ForPT2060 software.



Click title of “PCM370ForPT2060 Plant Condition Management” on main window to view About PCM370ForPT2060 Window.

Exit

Click Exit on main window to exit from the software.

PCM370ForPT2060 Maintenance

Special Notes

1. Measurement units of “HZ” and “RPM” in PT2060 are replaced with “EU” in PCM370ForPT2060 software.
2. PCM370ForPT2060 software can monitor maximum PT2060 Racks at the same time. Only PT2060/10, PT2060/20, PT2060/30, and PT2060/53 modules on PT2060 Racks are monitored. The total number of PT2060/10, PT2060/20, PT2060/30, and PT2060/53 modules in all PT2060 Racks should be less than or equal to 32.
3. When the configuration information on PT2060 Racks is changed, you should re-upload the information on PCM370ForPT2060 software.

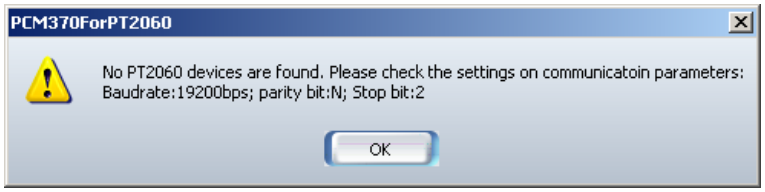
Troubleshooting

No PT2060 Racks are found

“No PT2060 Racks are found” window may appear when you are uploading the PT2060 Rack’s information.

***Condition 1:* When PT2060 Racks work in MODBUS-RTU transmission mode.**

If PCM370ForPT2060 software can’t find any PT2060 Racks by MODBUS-RTU transmission mode, you will see the following window:


PCM370ForPT2060
No PT2060 devices are found. Please check the settings on communicatoin parameters:
Baudrate:19200bps; parity bit:N; Stop bit:2
OK

In this condition, you should check the communication parameters’ setting on PT2060 Racks first by PT2060-CFG software.

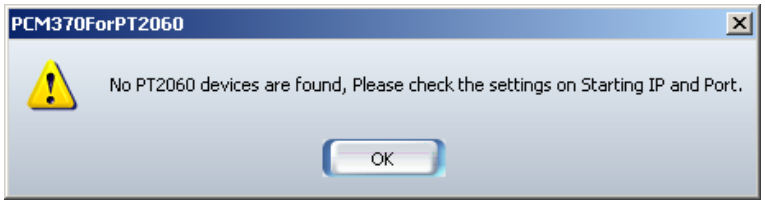
- ✓ Baud Rate: 19200
- ✓ Parity Bit: None
- ✓ Stop Bit: 2
- ✓ Slave Address: the value from 1 to 5 is invalid

After checked the settings on racks’ communication parameters, you can re-start PCM370ForPT2060 software and then upload the PT2060 information again. If the software can’t find the PT2060 Racks yet, please check:

- ✓ The PT2060 Racks are powered.
- ✓ The cables are good.
- ✓ The wiring between computer and PT2060 Racks is correct.
- ✓ The PT2060/91 module on PT2060 Rack works normally.

***Condition 2:* When PT2060 Racks work in MODBUS-TCP transmission mode.**

If PCM370ForPT2060 software can't find any PT2060 Racks by MODBUS-TCP transmission mode, you will see the following window:



In this condition, you should check the settings on Starting IP and Port. And mark sure the IP setting on PCM370ForPT2060 software matches the IP address of PT2060 Racks. And make sure the current Port is available.

After checked the settings on Starting IP and Port, you can re-start PCM370ForPT2060 software and upload the PT2060 information again. If the software can't find the PT2060 Racks yet, please check:

- ✓ The PT2060 Racks are powered.
- ✓ The network cables are good.
- ✓ The wiring between PT2060 Racks and computer is correct.
- ✓ The PT2060/91 module on PT2060 Rack works normally.

Communication Error

"Communication Error" window may appear when you are uploading the PT2060 Rack's information.

If the window pops up in process of uploading PT2060 Rack's information, this means that PCM370ForPT2060 software has found the PT2060 Rack and some unpredictable error happens in the uploading.

In this condition, you should upload the information again. If the communication error always happens, you should check the modules on PT2060 Rack. Ensure that all modules work normally. You can use PT2060-CFG software to check that.

Communication Failed

"Communication Failed" window may appears when PCM370ForPT2060 software works in displaying status.

Link Information
Communication failed! Firstly, you should check the connection between computer and PT2060 Rack. Secondly, restart the PCM370ForPT2060 software.
Cancel

Please check:

- ✓ The PT2060 Racks are powered;
- ✓ All cables are good;
- ✓ The parameters on PT2060 Racks match the parameters on PT2060 Racks;

After checked the connection between computer and PT2060 Racks, please re-start PCM370ForPT2060 software.

Appendix Glossary

This glossary is a partial list of terms and definitions used in the field of rotating machinery measurement, monitoring, and analysis. These definitions are not universal, but are expressed in the context of this specialized field. In some instances, ProvibTech Corporation has redefined terms from other technical fields for its own purposes.

Alphabetical Index Abbreviations

*** Absolute Vibration**

Vibration of an object as measured relative to an inertial (fixed) reference frame. Accelerometers and velocity transducers measure absolute vibration typically of machine housings or structures; thus they are referred to as seismic transducers or inertial transducers.

*** Acceleration**

The time rate of change of velocity. For harmonic motion, this is often expressed as g or a. Typical units for acceleration are feet per second per second (ft/s2), meters per second per second (m/s2), or more commonly "g" (where g = acceleration of earth's gravity = 386.1 in/s2 = 32.17 ft/s2 = 9.81 m/s2). Acceleration measurements are generally made with piezoelectric accelerometers and are typically used to evaluate high frequency machine casing or bearing housing response characteristics.

*** Accelerometer**

An accelerometer is an inertial transducer which converts the acceleration characteristic of vibration into a proportional electric signal.

*** Acceptance Region**

Trend information of the 1X or 2X vibration vectors (amplitude and phase lag angle) presented in polar format, or the shaft average centerline position in Cartesian format. The user defines the normal Acceptance Region for each shaft radial vibration or position measurement on the machine, based on historical data for the machine under all normal operating conditions.

Some systems provide hardware and/or software alarm (Alert and Danger) set point capability. Alarm set points are set independently for maximum and minimum values of both amplitude and phase. Acceptance Region information is the most important indicator of a shaft crack.

*** Aero-derivative**

Aircraft jet engines that have been adapted and modified for industrial use.

*** Aliasing**

False frequency components caused by sampling a dynamic signal at too low a sampling frequency. The sampling frequency must be at least twice the highest frequency of interest or the highest frequency component in the signal. This effect can be eliminated by adjusting the sampling frequency, or using a low-pass filter on the signal prior to sampling (anti-aliasing.) The primary disadvantage of anti-aliasing (as is the case with virtually any type of filtering) is that phase and amplitude errors are incurred.

*** Alignment**

The positioning of machine components; bearings, rotors, casing, foundation, piping, etc., with respect to each other for efficient transfer of power. Various alignment requirements utilize different techniques of cold and hot machine measurement including optical, mechanical (dial indicators), electronic (proximity probes), and laser.

*** Amplification Factor, Non-synchronous**

A measure of the susceptibility of a rotor system vibration response to a non-synchronous harmonic exciting force at a rotor system natural frequency. Synchronous amplification factor differs from non-synchronous amplification factor due to the existence of destabilizing tangential forces which depend on shaft rotative speed. At high rotative speeds these destabilizing factors cause a decrease in system quadrature dynamic stiffness and result in a non-synchronous amplification factor higher than the synchronous amplification factor.

*** Amplification Factor, Synchronous**

A measure of the susceptibility of a rotor system vibration response to an imbalance-related exciting force when shaft rotative speed is equal to a rotor system natural frequency. A calculation technique is similar to measuring the Q of a filter (the center frequency divided by the bandwidth), i.e., the balance resonance speed divided by the difference between the speeds at the -3dB amplitude values. Caution should be used when applying this latter method because of the potential mechanical abnormalities of machinery vibration response.

In general, a high synchronous amplification factor indicates low system quadrature dynamic stiffness, whereas a low amplification factor generally indicates high system quadrature dynamic stiffness.

Due to several factors, amplification factor measured during machine startup is different from that measured during coast down. Also called machine Q, synchronous amplification factor differs from non-synchronous amplification factor by an amount related to the existence of a tangential force which depends on actual shaft rotative speed. See Dynamic Stiffness, Quadrature.

*** Amplitude**

The magnitude of periodic dynamic motion (vibration). Amplitude is typically expressed in terms of signal level, e.g., millivolts or milliamps, or the engineering units of the measured variable, e.g., mils, micrometres (for displacement), inches per second (for velocity), etc. The amplitude of a signal can be measured in terms of peak-to-peak, zero-to-peak, root mean square, or average.

*** Amplitude and Phase Versus Time (APHT)**

An acronym used to describe the trend plot of plot vibration amplitude and phase data. This data may be presented in both Cartesian and polar formats. Commonly used for 1X, 2X and nX vibration data.

*** Anti-aliasing Filter**

A low-pass filter which is used to eliminate false frequency components from the spectrum of a digitally sampled signal. See Aliasing.

*** Anti-Swirl**

A technique used in fluid handling machines to decrease or prevent the development of fluid circumferential flow around the rotor in bearings and seals, and to improve rotor stability.

*** Asynchronous or Non-synchronous**

Vibration frequency component which is different than shaft rotative speed. Sometimes used to mean any vibration frequency which is not an integer multiple or fraction of rotative frequency. See Synchronous.

*** Attitude Angle**

The included angle between the direction of the vector sum of all the unidirectional, steady state, radial loads (Preloads) on a rotor and a line connecting the bearing and shaft centers. Sometimes confused with Rotor Position Angle, since the preload historically and incorrectly, was considered to be primarily gravity on horizontal machines. See Rotor Position Angle and Eccentricity Ratio, Average.

*** Average**

An amplitude detection technique used for sine wave vibration signals; the half cycle average is 0.637 x zero-to-peak amplitude. Average amplitude detection is not used by ProvibTech because machinery vibration signals are most often non-sinusoidal in form and the peak-to-peak, or peak amplitude, cannot be correctly computed.

*** Average Shaft Position**

The static or average position of the shaft relative to a stationary component on the machine to which the probe is mounted. The most common application is rotor axial thrust position relative to the thrust bearing. Another important application is shaft average radial position in the bearing. These measurements are made using the dc (position) component of the proximity probe signal. Two proximity probes mounted in an XY configuration are required for the two-dimensional radial position measurement.

*** Axial**

In the same direction as the shaft centerline.

*** Axial Position**

The average position, or change in position, of a rotor in the axial direction with respect to some fixed reference. Typically, the reference is the thrust bearing support structure or other casing member to which the probe is mounted. The probe may observe the thrust collar directly or some other integral, axial shaft surface, as long as it is within about 12 inches of the thrust bearing. Also called thrust position. See Differential Expansion.

*** Balance-of-Plant Machinery**

That group of rotating machinery which is not critical to any part of the overall plant process. Many of these machines operate in tandem or spared installations.

*** Balance Resonance Speed**

A shaft rotative speed (or speed region) which equals a natural frequency of the rotor system. When a rotor accelerates or decelerates through this speed region, the observed vibration characteristics are (1) a peak in the 1X Amplitude and (2) a more rapid change in the 1X vibration phase lag angle.

*** Balancing**

Adjusting the radical mass distribution of a rotor so that the mass centerline (principal inertia axis) approaches or coincides with the rotor rotational axis. This reduces the 1X lateral vibration of the rotor and the forces on the bearings due to imbalance inertia forces.

*** Band-Pass Filter**

A filter that has a single transmission band extending from a non-zero lower corner frequency to a finite upper corner frequency. The corner frequencies are the frequencies on either side of the center frequency where the amplitude is attenuated by 3dB. At the center frequency, the signal amplitude is not attenuated.

*** Bandwidth**

The span between the corner frequencies of a band-pass filter. Normally expressed in terms of frequency for constant bandwidth filters and as a percent of the center frequency for constant percentage (constant Q) filters. See Band-Pass Filter.

*** Blade Passing Frequency**

A potential vibration frequency on any bladed machine (turbine, axial compressor, fan, propeller, etc.). It equals the number of blades (on a disk or stage) times shaft rotative speed.

*** Bode Plot**

A pair of graphs in Cartesian format displaying the 1X vibration vector (phase and amplitude) response as a function of shaft rotative speed. The Y axis of the top graph represents 1X phase lag angle, while the Y axis of the bottom graph represents 1X amplitude. The common X axis represents shaft rotative speed. Sometimes called an imbalance response plot. Also used for 2X, 3X, ETC. .Vibration response vectors.

*** Bow**

A shaft condition such that the geometric shaft centerline is not straight. Usually the centerline is bent in a single plane due to gravity sag, thermal warpage, etc.; however, the bow may be three dimensional (corkscrew). Shaft bow can be detected by measuring the shaft relative displacement with a proximity probe(s) at rotor slow roll speed. See Eccentricity Peak-to-Peak.

*** Calibration Weight**

Used in rotor balancing procedures, a weight of known magnitude which is placed on the rotor at a known location, under known operating conditions, in order to measure the resulting change in machine 1X vibration response. In effect, such a procedure "calibrates" the rotor system (a known input is applied, and the resultant output is measured) for its susceptibility to imbalance. Sometimes called "trial weight"

*** Campbell Diagram**

A diagram used in rotating machinery design. A tool for selecting and checking shaft operational rotative speeds and other possible forcing function frequencies against the spectrum of natural frequencies to avoid resonances. The X axis represents the various

possible excitation frequencies, i.e., rotative speed (1X), oil whirl (.40-.48X), blade or vane passing frequencies, gear mesh frequencies, etc. The Y axis represents the lateral and torsional natural frequencies. The term is sometimes used incorrectly to describe the Cascade Plot and Waterfall Plot. See torsional vibration

*** Cartesian Format**

A rectangular graphical format consisting of a vertical (Y) axis and a horizontal (X) axis. This format is used to graph the results of one variable as a function of another; e.g., vibration amplitude versus time (trend), amplitude versus frequency (spectrum) and nX amplitude versus shaft rotative speed (Bode).

*** Cascade Plot**

A graph in Cartesian format displaying amplitude versus frequency spectra at series shaft rotative speeds. Shaft rotative speed and amplitude are usually presented on two separate vertical axes. Frequency is measured on the horizontal (X) axis. This data format is used to evaluate the change in vibration frequency characteristics during machine transient conditions. See Waterfall Plot.

*** Casing Expansion**

A measurement of the axial position of the machine casing relative to a fixed reference, usually the foundation. The measurement is typically made with an LVDT installed on the foundation at the opposite end of the machine from the point where the casing is attached to the foundation. Changes in casing axial position are the result of thermal expansion and contraction of the casing during startup and shutdown. The measurement is usually incorporated as part of a TSI system.

*** Center Frequency**

For band-pass filters the arithmetic center of a constant bandwidth filter or the geometric center (midpoint on a logarithmic scale) of a constant percentage filter.

*** Channel**

A transducer and the instrumentation hardware to display its output signal.

*** Cold Water Stands**

An arrangement of piping and brackets installed along a machine foundation for hot alignment measurements. Proximity probes observe exposed shaft areas or targets on the machine casing from brackets through which water circulates. This provides a thermally stable reference for the alignment measurement.

*** Communications Processor**

An interface module used in an on-line monitoring system to communicate data from the monitor rack to the computer. ProvibTech Communications Processors include Dynamic Data Manager (steady state static data and steady state dynamic data), Transient Data Manager (steady state, transient static data and transient dynamic data), and Process Data Manager (process variable data).

*** Constant Bandwidth Filter**

A band-pass filters having a fixed frequency bandwidth regardless of center frequency.

*** Constant Percentage Filter**

A band-pass filters whose bandwidth is a fixed percentage of the center frequency. Also called constant Q filter.

*** Critical Machinery**

That group of rotating equipment which is absolutely necessary to a major part of the plant process. When critical machinery is not operating, that part of the process is not operating. Machines in this category are usually un-spared and are typically monitored continuously.

*** Critical Speed(s)**

In general, any shaft rotative speed which is associated with high (dangerous level) vibration amplitude. Often, critical speed is used to describe a shaft rotative speed equal to a rotor system natural frequency. This is more correctly called a balance resonance speed.

*** Critical Speed Map**

An XY (Cartesian) diagram used in rotating machinery design as a tool to approximate the effect of changes in bearings supports, and pedestal designs on system natural frequencies. The X axis represents bearing stiffness and the Y axis represents rotor system natural frequency.

*** Cross Axis Sensitivity**

The ratio of change in the signal output to an incremental change in the input along any axis perpendicular to the sensitive axis of an inertial (seismic) transducer.

*** Cross Talk**

Interference or noise in a transducer signal or channel which originates in another transducer or channel. When using proximity probes, cross talk can occur when the tips of two (or more) probes are too close together. The interaction of the probes' electromagnetic fields causes a noise component in each of the transducers' output signals. The frequency of the noise component is the difference (beat frequency) of the two proximate oscillator frequencies.

*** Cycle**

One complete sequence of values of a periodic quantity.

*** Decibels**

A numerical expression of the ratio of the power or voltage levels of electrical signals. dB = 10 log P1/P2 = 20 log V1/V2.

*** Difference Analysis**

A method for evaluating the change in a measurement variable. Two sets of data are collected at different points in time, or under different conditions, and are subtracted from each other.

*** Differential Expansion**

The measurement of the axial position of the rotor with respect to the machine casing at some distance from the thrust bearing. Changes in axial rotor position relative to the casing affect axial clearances and are usually the result of thermal expansion during startup and shutdown. The measurement is typically made with a proximity probe transducer mounted to the machine casing and observing an axial surface (e.g., collar) of the rotor. The measurement is usually incorporated as part of a TSI system.

*** Differential Phase**

A technique which measures the phase difference between vibration signals of a chosen single frequency at different longitudinal locations on a rotor system. It is used for location of the source of instability. The vibration signal whose phase leads all others usually indicates the transducer location closest to the source of the instability.

*** Direct Data**

Data or a signal, which represents the original transducer signal. Sometimes called unfiltered, raw, all pass, or overall data or signal.

*** Displacement**

The change in distance or position of an object relative to a reference. Machinery vibration displacement is typically a peak-to-peak measurement of the observed vibrational motion, and is usually expressed in units of mils or micrometres. Proximity probes measure displacement directly. Signal integration is required to convert a velocity signal to displacement.

*** Dual Path**

A signal conditioning technique used in vibration monitors whereby a single transducer input is processed through two separate signal conditioning paths in the monitor. Each signal conditioning path can have its own engineering units of measurement (e.g., displacement and velocity), optional filtering, alarm set points and displays.

*** Dual Probe**

A transducer set consisting of a proximity probe and velocity transducer installed radially at the same point (usually in a common junction box on the machine bearing housing). Four separate measurements are provided by this transducer system. The proximity probe measures (1) shaft relative radial position within the bearing clearance, and (2) shaft dynamic motion relative to the bearing. The

velocity transducer measures (3) machine casing absolute vibration. When the velocity signal is integrated to displacement and added to the shaft relative signal, the summation represents (4) shaft absolute motion.

*** Dual Voting**

A logical AND relationship between two independent monitor inputs; they must agree before any action is taken. For example, two transducer input signals must both exceed an amplitude set point (usually the Danger set point only) before an actual alarm condition is indicated by the monitor. If only one transducer input exceeds the set point, then no alarm is initiated in the monitor.

*** Dynamic Data**

Data (steady state and/or transient) which contain that part of the transducer signal representing the dynamic (e.g., vibration) characteristics of the measured variable. Typical dynamic data presentations include Orbit, Timebase, spectrum, Polar, Bode, Cascade, and Waterfall. From this data it is possible to derive static data such as amplitude, frequency filtered amplitude, and phase lag angle from the signal. See Steady State Dynamic Data and Transient Dynamic Data.

*** Dynamic Stiffness**

Spring stiffness of the mechanical system complemented by the dynamic effects of mass and damping which act against an applied dynamic force to limit vibration response.

*** Dynamic Stiffness, Direct**

The component of mechanical system Dynamic Stiffness, consisting of modal mass, stiffness, and cross couple damping terms, which collinearly opposes the applied force.

*** Dynamic Stiffness, Quadrature**

The component of a Dynamic Stiffness mechanical system Dynamic Stiffness in a fluid environment, consisting of 1) the viscous damping (the reaction of the fluid when the shaft presses on it); and 2) the fluid wedge support term (the reaction of the shaft when the fluid pushes on it). The latter is cross-coupled stiffness (tangential force component). Quadrature dynamic stiffness acts perpendicularly to the applied force (90 degrees out of phase).

*** Eccentricity, Mechanical**

The variation of the outer diameter of a shaft surface when referenced to the true geometric centerline of the shaft. Out-of-roundness. See Mechanical Runout.

*** Eccentricity Peak-to-Peak**

The measurement of shaft bow at slow roll speed. The shaft bow may be due to; (1) fixed mechanical bow, (2) temporary thermal bow, or (3) temporary bow due to any sort of sag or bow at rest, sometimes called gravity bow.

*** Eccentricity Ratio, Average**

A dimensionless quantity representing the average position of the shaft within the bearing (or seal). The average eccentricity ratio, obtained by dividing the distance between the average position of the shaft centerline and the bearing (seal) centerline by the radial clearance, can vary between zero and one. Zero represents the shaft concentric with the bearing (seal), and one represents the shaft in contact with the bearing (seal). A trend of decreasing eccentricity ratio can indicate a potential stability problem. See Rotor Position Angle and Attitude Angle.

*** Eccentricity Ratio, Dynamic**

A dimensionless quantity representing the instantaneous position of the shaft within the bearing (or seal). The dynamic eccentricity ratio, obtained by dividing the distance between shaft and bearing (seal) centerlines by the radial clearance, can vary between zero and one. Zero represents the shaft concentric with the bearing (seal), and one represents the shaft in contact with the bearing (seal). See Eccentricity Ratio, Average.

*** Eddy Current**

Electrical current which is generated in a conductive material when such material intercepts the electromagnetic field of a proximity probe.

*** Electrical Runout**

A noise component in the output signal of a proximity probe transducer system resulting from non-uniform electrical conductivity and magnetic permeability properties of the observed material. Also caused by local (spot) magnetic fields on the circumference of the shaft surface. A change in the Proximate output signal which does not result from a probe gap change (dynamic motion or change in average shaft position). The error repeats exactly with each shaft revolution. See Mechanical Runout.

*** Element Passage Frequency**

(EPx) For purposes of studying rolling element bearings, using either bearing housing transducers or the ProvibTech REBAM system, EPx is a symbolic indication of the rate at which rolling elements pass a fixed point on either the inner or outer race. Harmonics of the element passage frequency are then indicated as 2EPx, 3EPx, .., nEPx.

*** Error**

The difference between the indicated value and the true value of the measured variable. It is often expressed as relative error, i.e., as a percent of the output reading of the transducer.

*** Essential Machinery**

That group of rotating equipment which is critical to part of the plant process. When essential machinery is not operating, the overall plant is not operating to full capacity. Machines in this category can be spared or un-spared and are typically monitored continuously.

*** Filter**

Electronic circuitry designed to pass or reject a specific frequency band of a signal.

*** Fluid Circumferential Average Velocity Ratio**

A dimensionless ratio of the average rate of rotation of a fluid (in a bearing or seal clearance or in rotor to stator periphery) in the direction of shaft rotation divided by shaft rotative speed. Lambda times rotative speed is the angular velocity at which the fluid force rotates. Sometimes this is used as the ratio of oil (fluid) whirl frequency to rotative frequency (approximate value).

*** Fluid Induced Instabilities**

Rotor self-excited lateral vibrations (whirl and whip) due to fluid/solid interaction in bearings, seals, and other "cylinder within a cylinder" parts of a machine.

Whirl causes the shaft dynamic motion to be forward and circular (or elliptical), and at a frequency proportional to shaft rotative speed. The vibration frequency of whirl is a function of the fluid circumferential average velocity in the bearing, seal or rotor periphery. Typically whirl for bearings varies from 0.3X to 0.49X (just less than one-half of shaft rotative speed).

Whip occurs when whirl vibration frequency approaches a rotor system's natural frequency, most often the rotor first balance resonance. The mechanism is not limited to oil lubricated bearings, but can occur when any fluid (e.g., oil, steam, process gas, etc.) is enclosed within a small clearance area between two body surfaces, one of which is rotating and dragging the enclosed fluid into circumferential rotation. While the fluid average frequency is then usually below half rotative speed, changes may occur when the fluid is tangentially accelerated, for instance due to recirculation, or decelerated such as in anti-swirl seals.

*** Forced Vibration**

The response vibration of a mechanical system due to a forcing function (exciting force). Typically, forced vibration has the same frequency at that of the exciting force.

*** Free Vibration**

Vibration response of a mechanical system following an initial perturbation (change of position, velocity or force). Depending on the kind of perturbation, the mechanical system responds with free vibrations at one or more of its natural frequencies.

*** Frequency**

The repetition rate of a periodic vibration per unit of time. Vibration frequency is typically expressed in units of cycles per second (Hertz) or cycles per minute (to more easily relate to shaft rotative speed frequency). In fact, since many common machine malfunctions produce vibration which has a fixed relationship to shaft rotative speed, vibration frequency is often expressed as a function of shaft rotative speed. 1X is a vibration with a frequency equal to shaft rpm, 2X vibration is twice shaft rpm, 0.5X is a frequency equal to one-half shaft rpm, etc.

*** Frequency Component**

The amplitude, frequency and phase characteristics of a component of a dynamic signal.

*** Frequency Response**

The measured amplitude and phase response characteristics of a mechanical or electronic system with respect to frequency.

*** g**

The value of acceleration yielded by the force of earth's gravity, which varies somewhat with latitude and elevation. By international agreement, 9.8 m/s2 = 386 in/s2 = 32.17 ft/s2 has been chosen as the standard acceleration due to gravity.

*** Gear Mesh Frequency**

A potential vibration frequency on any machine which contains gears. It equals the number of gear teeth times shaft rotative speed.

*** Harmonics**

A series of vibration signal components whose frequencies are integer multiples of the fundamental, or lowest frequency, vibration component.

*** Harmonic Vibration**

Sinusoidal vibration with a single frequency component.

*** Heavy Spot**

A term used to describe the position of imbalance. It is the angular location of the imbalance vector (the summation of the mass imbalance distribution) at a specific lateral location (in one plane) on a rotor. See High Spot.

*** Hertz**

(Hz) Unit of frequency measurement in cycles per second.

*** High Frequency**

For purposes of studying rolling element bearings, a frequency range, typically above 5 kHz, used to measure the very high vibration frequencies associated with microscopic faults in bearing components.

While this technique may provide the earliest warning of impending bearing failure for some types of bearing faults, there are several other machine malfunctions which can produce vibrations in this range (e.g., cavitation, rubs, etc.) In addition, the high frequency measurement technique sometimes provides warnings too early, long before any maintenance (bearing replacement) needs to be considered.

*** High-Pass Filter**

A filter having a single transmission band extending from some finite lower corner frequency (defined as the point where amplitude is attenuated by 3 dB) to infinite frequency (or the upper frequency response limit of the transducer or instrument).

*** High Spot**

The term used to describe the response of the shaft due to imbalance force. It is the angular location on the shaft directly under the vibration probe when the shaft makes its closest approach to that probe. Also, the location on the shaft surface under a proximity probe when the 1X filtered vibration signal produced by the probe reaches its positive peak.

*** Hysteresis**

The difference in levels (dead band) between the trigger threshold and the reset designed to reduce false triggering.

*** Inertially Referenced**

Motion that is referenced to a mass whose inertia keeps it stationary, yielding absolute motion. Also describes a transducer with an internal inertial reference mass.

*** Influence Vector**

Used in balancing, the 1X vibration response vector due to a calibration weight, divided by the calibration weight vector at a particular shaft rotative speed. The measured vibration vector divided by the unbalance force vector represents the rotor's transfer function. If the description of the influence vector contains the shaft rotative speed term and the radius at which the calibration weight is placed on (or removed from) the rotor, the influence vector is the inverse of the synchronous dynamic stiffness vector. See Influence Vector, Direct and Influence Vector, Longitudinal.

*** Influence Vector, Direct**

An influence vector where the measured vibration vector and the unbalance force vector are at or near the same plane along the rotor axis.

*** Influence Vector, Longitudinal**

An influence vector where the measured vibration vector and the unbalance force vector are at different longitudinal planes along the rotor axis.

*** Integrator**

An electronic circuit that converts a velocity signals to a displacement signal or converts an acceleration signal to a velocity signal.

*** Isotropic Supports**

Rotor support systems that provide uniform dynamic stiffness in all radial/lateral directions.

*** Keyphasor Pulse**

That change in the output signal of the Keyphasor Transducer caused by the Keyphasor Event.

*** Keyphasor Transducer**

A transducer that produces a once-per-shaft-turn voltage pulse, called the Keyphasor signal. This signal is used primarily to measure shaft rotative speed and as a reference for measuring vibration phase lag angle. It is an essential element in measuring rotor slow roll bow/runout information.

The Keyphasor transducer is typically a proximity probe (recommended for permanent installations in which the probe observes a physical gap change event), an optical pickup (used for temporary installations in which the pickup observes a change in reflectivity event) or a magnetic pickup. Keyphasor is a ProvibTech registered trademark.

*** Linearity (Calibration)**

The closeness of a calibration curve to a specific straight line, expressed as the maximum deviation of any calibration point on a specified straight line, in any one calibration increment.

*** Load Zone**

An angular region around a rolling element bearing where there is maximum compressive force between the shaft and the outer race of the bearing. Probes for bearing activity measurement (REBAM) would normally be placed in this zone for best (or most sensitive) measurements. Also, the direction of steady state load on any, including fluid film, bearing. "Normal" load can result from the force of gravity (for horizontal machines), gear mesh forces, fluidic forces, etc.

*** Low-Pass Filter**

A filter having a single transmission band extending from zero frequency (or the lower frequency response limit of the transducer or instrument) to some finite upper corner frequency (defined as the point where amplitude is attenuated by 3 dB).

*** LVDT**

Acronym for Linear Variable Differential Transformer. A contacting displacement transducer consisting of a movable core and a stationary transformer. The core is attached to the part to be measured and the transformer is attached to a fixed reference. The most

common application is casing expansion measurement where the core is attached to the casing and the transformer (LVDT housing) is attached to the machine foundation. Also used for valve position measurements.

*** Mechanical Runout**

A noise component in the output signal of a proximity probe transducer system; a probe gap change which does not result from either a shaft centerline position change or shaft dynamic motion. Common sources include out-of-round shafts, scratches, chain mark, dents, rust or other conductive build-up on the shaft, stencil mark, flat spots, and engravings. See Runout and Electrical Runout.

*** Micro-inch**

A unit of length or displacement equal to 10^-6 inches or 10^-3 mils.

*** Micro-metre**

A unit of length or displacement equal to 10^-6 metres. One micro-metre equals 0.0394 mil. Also called micron (obsolete).

*** Micro-Prox**

A high sensitivity ProvibTech Proximitor used to accurately and rapidly measure probe gap changes of a few micro-inches.

*** Mil**

A unit of length or displacement equal to 0.001 inch. One mil equals 25.4 micrometres.

*** Mode Shape of the Rotor**

The deflected shape of a rotor at a specific rotative speed caused by an applied specific forcing function such as imbalance. Note, this is a three dimensional presentation of rotor lateral (See Lateral Vibration) deflection in vibration mode along the shaft axis.

*** Modulation, Amplitude (AM)**

The process whereby variation in the amplitude of a vibration signal results in modulation of the amplitude of a carrier signal. AM is used when high frequency signal recordings are needed (i.e. gear mesh). AM tape recorders, also called direct, have a finite lower frequency response above zero (dc) Hertz. They capture dynamic data above the lower response frequency, but not the average shaft position data (dc voltage) which is available from a proximity probe signal.

*** Modulation, Frequency (FM)**

The process whereby variation in the amplitude of a vibration signal results in a variation a carrier frequency. FM tape recordings have a low frequency response down to dc (zero Hertz). This allows recording of proximity probe dc gap voltages which represent average shaft position.

*** Narf**

Acronym for Natural Axial Resonant Frequency; usually refers to axially compliant couplings.

*** Natural Frequency**

The frequency of free vibration of a system. The frequency at which a lightly damped system will oscillate upon momentary displacement from its steady position by a transient force. The natural frequencies of a multiple degree of freedom system are the frequencies of the normal modes of vibration. See Resonance.

*** Nodal Point (Node)**

A point of minimum (or zero) shaft deflection in a specific mode shape. May readily change location along the shaft axis due to changes in residual imbalance or other forcing functions, or due to changes in dynamic stiffness such as increased bearing clearance. This is often a location of minimum shaft absolute displacement. Vibration immediately on each side of the node is 180 degrees out of phase. See Pivotal/Conical Diagram under Mode Shape.

*** Noise**

Any component of a transducer signal which does not represent the variable intended to be measured.

*** Non-symmetric (Anisotropic) Rotor**

A rotor whose cross-section has two different geometric moments of inertia (for example, an elliptical cross-section) and/or the supports have different stiffness characteristics in the horizontal and vertical directions. See Symmetric Rotor.

*** Notch Filter**

A filter which has a single rejection band extending from a finite lower cutoff frequency greater than zero to a finite upper cutoff frequency. Frequencies within the rejection band are eliminated or attenuated while frequencies outside the rejection band are retained. The opposite of a band-pass filter.

*** Nulling**

Subtraction of the shaft slow roll speed value for 1X electrical runout or mechanical runout vector component from the corresponding transducer signal nX vector component.

*** Nyquist Plot**

A type of graphical presentation in polar format used to evaluate the stability of an automatic control system. This term should not be used to describe a similar polar presentation of machine vibration vector data. See Polar Plot.

*** Octave**

A 2 to 1 ratio between two frequencies. An octave higher than some frequency F is 2F; an octave lower is one-half F.

*** 1X**

In a complex vibration signal, notation for the signal component that occurs at the rotative speed frequency. Also called synchronous.

*** 1/2X, 1/3X, 2/5X, 4/9X, ETC.**

In a complex vibration signal, notations for signal components having frequencies equal to fractions of rotative speed. Also called sub-harmonic and sub-synchronous.

*** Optical Pickup**

A non-contacting transducer which emits light from an internal infrared LED, and detects the level of reflected light with a phototransistor. The most common application of this pickup is as a temporary Keyphasor transducer, observing a once-per-turn change in shaft reflectivity (dark or light paint spot or small strip of highly reflective tape on the shaft).

*** Orbit**

The dynamic, two dimensional path of the centerline motion of a machine component, which is observed by XY transducers, in the plane of those transducers. When the transducers are XY shaft proximity probes, it is the shaft centerline lateral vibration, called precession. Observed with an oscilloscope in the X versus Y mode. Sometimes called orbital motion, or Lissajous presentation.

*** Outer Race**

For rolling element bearings, a generally cylindrical component which is positioned between the rolling elements and the bearing housing.

*** Peak-to-Peak Value**

The difference between positive and negative extreme values of an electronic signal or dynamic motion. See Amplitude.

*** Period**

The time required for a complete oscillation or for a single cycle of events. The reciprocal of frequency.

*** Periodic Vibration**

Oscillatory motion whose amplitude pattern repeats in time.

*** Perturbation**

Application of a forcing function to a system by means of an external device in order to study the system characteristics. Also called excitation.

*** Perturbation Technique**

A part of modal testing. A method of identifying the dynamic characteristics of a mechanical system (rotors in particular) by comparing a known input force to the measured response. The perturbation force may be at any frequency, including shaft rotative frequency, (as in the case of unbalance) and zero frequency (zero speed), as in the case of a steady state load.

The perturbation force may be applied in one direction only (unidirectional), or in two directions simultaneously, as in the case of a circular or elliptical force. If the non-synchronous perturbation force is applied to the rotating shaft in two axes simultaneously, it may be forward (in the direction of shaft rotation) or reverse (against the direction of rotation).

Direct perturbation of the rotating shaft by a rotating force input of known force amplitudes, phase and frequency across ranges of all of these, while measuring the motion response vectors of the rotor system at the same frequency, can yield the meaningful dynamic stiffness of a rotor system. This methodology can be applied for identification of nonlinear, non-symmetric, and discontinuous systems.

A "gong" test (impulse test) may yield some basic simple data. A unidirectional swept sine perturbation applied to the support system is an improvement over the "gong" test. Swept sine input to the rotor by a known displacement is another improvement, but the readout must be the response force vector which is very difficult to instrument accurately.

*** Phase Lag Angle**

The timing relationship, in degrees, between two vibration signals, or a Keyphasor pulse and a vibration signal; also, the phase difference between two signals such as the input force signal and output response signal. The "lag" corresponds to "minus" in mathematical formulations.

*** Piezoelectric**

Any material which provides a conversion between mechanical and electrical energy. For a piezoelectric crystal, if mechanical stresses are applied on two opposite faces, electrical charges appear on another pair of faces.

*** Plant Summary Report**

Information available from on-line computerized monitoring systems typically representing the status of all measured variables, monitors, alarms, and trends for a user-defined time period (usually the previous work shift or 24 hours).

*** Polarity**

In relation to transducers, the direction of output signal change (positive or negative) caused by motion toward or away from the transducer in its sensitive axis. Convention is that motion toward the transducer will produce a positive signal change.

*** Polar Format**

A graphical format consisting of a center reference point surrounded by concentric circles. Vector information is graphed on this format by plotting magnitude (vibration amplitude) as the length of a radial line, and phase (vibration phase lag angle) as the clock position of the line.

*** Polar Plot**

Polar format presentation of the locus of the 1X (or 2X,...) shaft vibration vector from a single channel as a function of shaft rotative speed. The Polar Plot is generated by in-phase and quadrature signals, usually during machine startup or coast down (transient operation). This plot is sometimes incorrectly called a Nyquist Plot.

*** Preload**

A unidirectional, radial (side) load due to external or internal mechanisms. Categorized as a "soft" or "hard" preload. A soft preload may shift in direction or magnitude, and can act to stabilize or destabilize the dynamic condition of the machine. A hard preload is usually fixed and acts to stabilize.

*** Prime Spike**

In the study of rolling element bearings, a frequency range which encompasses, as a minimum, the primary bearing fault frequencies and harmonics.

*** Probe Gap**

The physical distance between the face of a proximity probe tip and the observed surface. The distance can be expressed in terms of displacement mils, micrometres, or in terms of voltage (millivolts). Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

*** Probe**

Specifically, a proximity probe transducer, although sometimes used to describe any transducer.

*** Probe Orientation**

The angular location of a probe with respect to a polar coordinate system when viewed from the driver end of the machine. Typically, zero degrees are at top dead center (vertical) or at the horizontal right (3 o'clock) position on the coordinate system.

*** Proximitor**

A ProvibTech signal conditioning device which sends a radio frequency signal to an eddy current proximity probe, demodulates the probe output, and provides output signals proportional to both the average and dynamic probe gap distances. Also called an oscillator-demodulator. Proximitor is a ProvibTech registered trademark.

*** Proximity Probe**

A non-contacting device which measures the displacement motion and position of an observed surface relative to the probe mounting location. Typically, proximity probes used for rotating machinery measurements operate on the eddy current principle and measure shaft displacement motion and position relative to the machine bearing(s) or housing. See Relative Transducer.

*** Q, Filter**

Filter selectivity, i.e, the relative band of frequencies passed or rejected by the filter. The narrower the band of frequencies, the higher the Q, and the broader the band, the lower the Q. This is computed by Q = fc / delta-f where fc is the center frequency and delta-f is the bandwidth of the filter at the 3dB points.

*** Q, Machine**

Derived from Q, Filter. Used to describe the synchronous amplification factor of a rotor system. See Synchronous Amplification Factor.

*** Radial**

A direction on a machine which is perpendicular to the shaft centerline in the XY plane; usually refers to direction of shaft lateral or casing motion or measurement.

*** Radial Vibration**

Shaft dynamic motion or casing vibration which is measured in a direction perpendicular to the shaft axis.

*** Raster Plot**

A type of Cascade or Waterfall plot, usually with a skewed Y axis so that the plot has an isometric appearance.

*** Real Time Analyzer**

A term used to describe an instrument which displays a vibration frequency spectrum.

*** REBAM**

An acronym for Rolling Element Bearing Activity Monitor, which is a ProvibTech method and system for monitoring and analyzing the performance of rolling element bearings using eddy current transducers and Micro-PROX .

*** Relative Vibration**

Vibration measured relative to a chosen reference. Proximity probes measure shaft dynamic motion and position relative to the probe mounting, usually the bearing or bearing housing.

*** Relative Transducer**

A proximity probe observing shaft motion relative to the probe mounting, usually the bearing or bearing housing.

*** Repeatability**

The ability of a transducer or readout instrument to repeat measurements, under the same conditions, within narrow limits. Precision is the measure of repeatability.

*** Resolution**

The smallest change in applied stimulus that will produce a detectable change in the instrument output.

*** Resonance**

The condition in which a forcing frequency coincides with a natural frequency of the system. A resonance typically is identified by an amplitude peak, accompanied by a maximum rate of change of phase lag angle. See Balance Resonance Speed.

*** Rod Drop**

On a reciprocating compressor, the measurement of the position change of the piston rod relative to a fixed reference point as the piston drops in the cylinder due to piston rider ring deterioration. The position measurement can indicate either the average position of the rod over the full stroke or the instantaneous position of the rod at a specific point in the stroke.

*** Rod Drop, Average Position**

On a reciprocating machine, the measurement of the average position change of a piston rod over the full stroke of the piston relative to a fixed reference on the cylinder. This measurement is usually achieved by evaluating the average dc gap voltage change of a proximity probe mounted to the fixed reference.

*** Rod Drop, Instantaneous Position**

On a reciprocating machine, the measurement of the position change of a piston rod at one specific event during the full stroke of the piston, relative to a fixed reference of the cylinder. This measurement is usually achieved by evaluating the instantaneous dc gap voltage change of a proximity probe mounted to the fixed reference. Timing of the measurement is provided by a Keyphasor probe.

*** Rolling Element Bearing**

(Antifriction Bearing) A bearing which uses rolling elements (rollers or balls) to support the load of a rotating shaft and to minimize friction.

*** Rolloff**

The rate of attenuation of amplitude and phase with respect to frequencies above (or below) a certain point. Thus a low-pass filter is designed to provide amplitude and phase rolloff at high frequencies, and a high-pass filter is designed to provide rolloff at low frequencies. Commonly rated in dB per octave.

*** Rolling Elements**

Components in a rolling element bearing (generally rollers or balls) which support the rotating load of a shaft.

*** ROMIS Rotating Machinery Information Systems and Services**

ProvibTech's ROMIS product offerings include on-line and periodic monitoring systems and diagnostic instruments/systems which provide information for operations personnel, plant engineers, and rotating machinery specialists including: overall values, trends, correlation of performance-related variables, steady-state dynamic data, and transient dynamic data. ROMIS is applicable to transducer and monitoring systems, diagnostics and test equipment, and services.

*** Root Mean Square (RMS)**

Square root of the arithmetic average of a set of squared instantaneous values. Used as a measure of amplitude; rms equals 0.707 x peak (sine wave only). (0.707 = 1/squareroot (2)). See Amplitude.

*** Rotor Position Angle**

The angle between an arbitrary reference through the center of a bearing (typically vertical down in a horizontal machine) and the line connecting the bearing and shaft centers, measured in the direction of rotor rotation. Used to indicate the presence of abnormal preloads on a machine, but NOT the stability of the rotor/bearing system. See Attitude Angle.

*** Rotor Vibration Region**

As applied to the study of rolling element bearings, using either bearing housing transducers or the ProvibTech REBAM system, a low-pass frequency range which includes vibration signals of the principal frequency components due to rotor/rolling element defects, but excludes any significant frequency components due to internal bearing defects. Typically, this frequency range is from one-fourth times shaft rotative speed (1/4X) to approximately three times shaft rotative speed.

*** RTD**

An acronym for Resistance Temperature Detector; a sensor which measures temperature and change in temperature as a function of resistance.

*** RUB**

Machine malfunction consisting of contact between the rotating and stationary parts of a machine involving friction, impacting, and changes in system stiffness.

*** Runout Compensation**

Electronic correction of a transducer output signal for the error resulting from runout. See Nulling

*** Scale Factor**

The change in output per change in input (sensitivity) of a transducer. Also, the factor by which a signal must be increased or decreased to meet the input requirements of an instrument.

*** Seismic Transducer**

Any vibration transducer which measures the absolute vibration of an object. Accelerometers and velocity transducers measure absolute vibration, typically of machine housing or structures, and thus are both referred to as seismic, or inertial, transducers.

*** Sensitivity**

The ratio of the change in the output to a change in the input. A typical sensitivity for a proximity probe transducer is 200 millivolts per mil (7.84 volts per millimetre).

*** Shaft Average Centerline Plot**

Transient or trend plot of the shaft average radial centerline position within the bearing clearance, presented in Cartesian format. See Average Shaft Position.

*** Shaft Rotative Speed**

The frequency at which a shaft is rotating at a given moment, usually expressed in units of revolutions per minute (rpm); may also be expressed in radians per second (mostly for laboratory work). 100 rpm equals approximately 10 radians per second; (100 rpm = 100 PI/30 radians per second).

*** Signal Attenuation**

A desired reduction in amplitude of a signal without changing the frequency and phase. Also, the decrease in amplitude and phase that results from the transmission of vibration energy from one machine part to another (e.g., shaft to bearing housing).

*** Signal Conditioner**

A device placed between a signal source and a readout instrument to change the signal. Examples: attenuators, preamplifiers, signal converters (for changing one electrical quantity into another, such as volts to amps or analog to digital), and filters.

*** Signal Gain**

The increase (or decrease) in magnitude of a signal. Also, the amount of voltage amplification utilized to enlarge small electronic signals up to full scale range on instruments such as FM tape recorders. This nondimensional number is usually in even steps of 2, 5, and 10.

*** Signature**

Term sometimes applied to a vibration frequency spectrum which is distinctive and special to a particular machine or component, system or subsystem at a specific point in time, under specific machine operating conditions, etc. Often fails to include the basic signal measurement of phase. Used for historical comparison of mechanical condition over the operating life of the machine.

*** Slow Roll Speed**

Low rotative speed at which dynamic motion effects from such forces as imbalance are negligible. The speed at which shaft bow and runout can be measured.

*** Spall**

In rolling element bearings, a flake or chip of metal removed from one of the bearing races or from a rolling element. Spalling is evidence of serious bearing degradation and may be detected during normal bearing operation by observing increases in the signal amplitude of the high frequency or Prime Spike region vibration signals.

*** Spectrum**

Commonly a presentation of the amplitudes of a signal's components as a function of its frequency.

*** Spectrum Plot**

An XY plot in which the X axis represents vibration frequency and the Y axis represents vibration amplitude.

*** Stability of a Mechanical System (Liapunoff Definition, Stability "In The Small")**

A mechanical system is stable if external small perturbation of its regime will create a resultant small change of the previous steady state regime. The perturbation can be introduced by applying an impulse force or changing the initial conditions of displacement and/or velocity. A system is asymptotically stable if small perturbation causes a decaying transient response, leading to the previous steady state regime.

Note that these definitions refer to some quantitatively undefined "small" actions. If a mechanical system exhibits several steady state regimes of motion, the definitions apply equally to each one. Note also that, according to these definitions, oil whirl is stable (while the rotor undergoes instability).

*** Stability of a Mechanical System (Practical Definition)**

A mechanical system is stable if any practical perturbation results in a system response with amplitudes within acceptable, prescribed levels.1

*** Stability of a Rotating Machine**

A rotating machine is stable if, at operating speeds, the rotational motion of all rotating elements (shafts, disks, blades, etc.) and the steady equilibrium of non-rotating parts (supports, bearings, cases, foundations, etc.) are not accompanied by various modes of vibration with amplitudes exceeding prescribed acceptable levels. This definition also applies to machine startups and coast downs when shaft rotative speed is variable.

*** Static Data**

Data which describes the quantitative characteristics of the measured parameter. Static data can also include quantitative values describing the conditions under which the parameter was measured. For predictive maintenance purposes, static data is typically presented in various forms of trend plot and displays/lists of current values. Examples of static data include vibration amplitude, phase lag angle, frequency, average shaft position, shaft rotative speed, time, date, monitor alarm and OK status.

*** Steady State Data**

Data (static and/or dynamic) acquired from a machine, at constant shaft rotative speed.

*** Steady State Dynamic Data**

Dynamic data acquired under steady state machine conditions. Typical data presentations include orbit, timebase and spectrum. This data can be instantaneously trended. See Dynamic Data and Steady State Data.

*** Steady State Static Data**

Static data acquired under steady state machine conditions. Example: shaft centerline position. See Static Data and Steady State Data.

*** Strain Gauge**

A transducer which reacts to changes in strain, typically through changes in resistance.

*** Stress**

A force acting on a body (e.g., shaft) per unit area. Usually measured in terms of lbs/in^2 or Newton/meter^2.

*** Sub-harmonic**

Sinusoidal component of a vibration signal that is a sub-multiple (integer fraction) of a fundamental frequency.

*** Sub-synchronous**

Component of a vibration signal which has a frequency less than shaft rotative speed.

*** Super-harmonic**

Sinusoidal component of a vibration signal that is an integer multiple of a fundamental frequency.

*** Super-synchronous**

Component of a vibration signal which has a frequency greater than shaft rotative speed.

*** Suppression**

The practice of using electronic circuitry to arithmetically subtract (suppress) the amplitude of an unwanted signal (noise). It is not recommended for vibration measurement and/or monitoring because most noise sources are vector, not scalar, quantities.

*** Sweep Frequency Filter**

A type of bandpass filter which is automatically swept (tuned) through a frequency range of interest. An instrument which incorporates this type of filter can be used to generate a vibration frequency spectrum. A change in the frequency content of the measured signal during the time required to sweep through the frequency range will cause the spectrum to smear.

*** Swirl Ratio**

See Fluid Circumferential Average Velocity Ratio.

*** Synchronous**

The component of a vibration signal that has a frequency equal to the shaft rotative frequency (1X).

*** Thermocouple**

A temperature sensing device comprised of two dissimilar metal wires which, when thermally affected (heated or cooled), produce a proportional change in electrical potential at the point where they join.

*** Threshold**

The level at which a trigger or other function is initiated.

*** Timebase Plot**

A presentation of the instantaneous amplitude of a signal as a function of time. A vibration waveform can be observed on an oscilloscope in the time domain.

*** Torque**

A measure of the tendency of a force to cause rotation. Equal to the force multiplied by the perpendicular distance between the line of action of the force and the center of rotation.

*** Torque, Average**

The constant amplitude component of the moment (force couple) applied to a rotor, in order to sustain rotational speed, angular acceleration or load requirements.

*** Torque, Dynamic**

The instantaneous amplitude of the time-varying component of the moment applied to a rotor, typically resulting from a variation in driving load or torque.

*** Torque, Static**

The force times the perpendicular distance between the force's line of action and the center of rotation (moment) as applied to a structure (non-rotating).

*** Torsional Vibration**

Time variation of the angle of twist, typically measured in tenths of degrees pp.

*** TorXimitorTM**

A ProvibTech non-contacting, signal conditioning device which senses strain and outputs a signal proportional to torque. TorXimitorTM continuously measures dynamic as well as static torque. TorXimitorTM is a trademark of ProvibTech Corporation.

*** Transducer**

A device for translating the magnitude of one quantity into another quantity. The second quantity often has units of measure different from the first and serves as the source of a useful signal. Vibration transducers convert mechanical motion into a proportional electronic signal (typically a voltage-proportional signal).

*** Transient Data**

Data (static and/or dynamic) acquired under transient machine conditions (startup and coast-down).

*** Transient Dynamic Data**

Dynamic data acquired under transient machine conditions. Typical transient dynamic data presentations include Polar, Bode and Cascade. See Dynamic Data and Transient Data.

*** Transient Static Data**

Static data acquired under transient machine conditions. See Static Data and Transient Data.

*** Transient Vibration**

The temporarily sustained vibration of a mechanical system. It may consist of forced or free vibration or both. Usually transient vibration is associated with instantaneous changes in machine condition such as speed, load, etc.

*** Trend Data**

The periodic recording/storage of static and/or dynamic data for the purpose of observing changes as a function of time. Trend data is the most fundamental level of information in any predictive maintenance program.

*** Trend Interval**

The time period between consecutive data points on a Trend Plot.

*** Trend Period**

The complete time frame (beginning to end of data) of a Trend Plot

***Trend Plot**

A presentation in Cartesian format or polar format of a plot with the measured variable versus time.

*** Trigger**

Any event which can be used as a timing reference. A trigger for an oscilloscope will initiate the sweep of the beam across the face of the CRT. A trigger signal for a digital vector filter is a Keyphasor pulse which serves to align the center frequency of the band-pass filter to shaft rotative speed. It provides a reference from which to measure shaft rotative speed, 1X amplitude and phase lag angle.

*** Trip Multiplier**

That function provided in a monitor system to temporarily increase the alarm (Alert and Danger) setpoint values by a specific multiple (usually two or three). This function is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations. Also called set point multiplier.

*** TSI**

Acronym for Turbine Supervisory Instrumentation. A TSI system is a continuous monitoring system generally used on turbogenerator sets. It can include such measurement parameters as shaft radial vibration, shaft absolute vibration, axial position, differential expansion, case expansion, valve position, eccentricity peak-to-peak, zero speed, and shaft rotative speed. The system may also include a vector filter which measures vibration phase lag angle for each vibration frequency. The TSI system consists of measurement transducers, monitors, interconnecting wiring and usually strip chart recorders or a microprocessor-based monitoring/data acquisition system.

*** 2X, 3X, ETC.**

In a complex vibration signal, notation for signal components having frequencies equal to exact multiples of shaft rotative speed. Also called harmonic, super-harmonic, and super-synchronous.

*** Unbalance**

Unequal radial mass distribution on a rotor system; a shaft condition where the mass centerline (principal inertial axis) does not coincide with the geometric centerline. Also, the effective mass that causes rotor vibration.

*** Valve Position**

A measurement of the position of the process inlet valves on a machine, usually expressed as a percentage of the valve opening; zero percent is fully closed, 100 percent is fully open. The measurement is usually made with an LVDT and is incorporated as part of a TSI system.

*** Vane Passing Frequencies**

A potential vibration frequency on vaned impeller compressors, pumps, and other machines with vaned rotating elements. It is represented by the number of vanes (on an impeller or stage) times shaft rotative speed.

*** Vector**

A quantity which has both magnitude and direction. For a vibration vector, magnitude is expressed as amplitude (displacement, velocity, or acceleration) and direction as phase lag angle (degrees). For example, the 1X vibration vector measured at shaft operating speed, e.g., for balancing purposes, will be described as a magnitude (mils or micrometres) acting in a particular direction (degrees). The vector data presentation which is easiest to interpret is the polar format. See Acceptance Region and Polar Plot.

*** Vector Filter**

An electronic instrument that automatically adjusts a band-pass filter center frequency to coincide with the frequency determined by an external electronic input pulse (Keyphasor). Typically, a digital vector filter is used to automatically filter a vibration signal at rotative speed (1X) frequency, (or 2X or other single frequency) especially under transient rotor speed conditions. Among other functions, a vector filter provides the dc proportional signals (shaft centerline).

*** Velocity**

The time rate of change of displacement. Typical units for velocity are inches/second or millimeters/second, zero-to-peak. Velocity measurements are used to evaluate machine housing and other structural response characteristics. Electronic integration of a velocity signal yields displacement.

*** Velocity Transducer**

An electromechanical transducer, typically of inertial design, used for measuring bearing housing and other structural absolute vibration. Seismoprobe is a ProvibTech registered trademark for this type of velocity transducer.

*** Velomitor®**

A piezoelectric velocity sensor with no moving parts that contains an accelerometer crystal and a built-in amplifier/integrator. This type of seismic sensor is used for casing vibration measurements on rotating machinery equipped with rolling element bearings and frame vibration measurements on reciprocating machinery. It measures absolute vibration relative to free space. Also see Seismic Transducer.

*** Vibration**

The oscillatory (back and forth) motion of a physical object.

*** Vibration Form**

The characteristics of vibration signals which may be observed on an oscilloscope. Typical displays are timebase waveform and shaft Orbit. See Orbit and Waveform.

*** Waterfall Plot**

Similar to Cascade plot, except that one vertical axis is usually time instead of shaft rotative speed (rpm). See Cascade Plot.

*** Waveform**

A presentation or display of the instantaneous amplitude of a signal as a function of time. A vibration waveform can be observed on an oscilloscope in the timebase mode.

*** Wobulator**

A mechanical device which generates dynamic motion of an observed surface at a known amplitude and frequency. The surface is observed by a proximity probe for the purpose of calibration of a vibration monitor. ProvibTech's TK3-2 incorporates a wobulator.

*** XY**

Orthogonal (perpendicular) axes in a Cartesian coordinate system. Usually used as a reference for orthogonal (mutually perpendicular) radial vibration transducers. Y represents the vertical axis and X represents the horizontal axis.

*** Zero-to-Peak Value**

One-half of the peak-to-peak value. See Amplitude.

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